THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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NOW READY.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1911 EDITION

H. ALABASTER, GATEHOUSE & CO.,

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COMMERCIAL ENGINEERING.

AN address under the above title was delivered the other day at the Birmingham Municipal Technical School, by Mr. M. Railing, manager of the Witton Works of the General Electric Co.

After repeating the usual eulogy on the British engineers of the past, referring to the leading position which Britain held among the nations of the world in the good old days, and bemoaning the fact that America and Continental countries have passed us by leaps and bounds and are now far ahead of us in actual results (we should be called "little Englanders" if we said half as much), the lecturer disclaims any intention of discussing the larger political aspect of the matter, "one which is dear indeed to Birmingham, but on which the rest of the country can hardly be said to have come to a definite conclusion." After this extraordinary pronouncement, Mr. Railing, having told us he does not propose to discuss the larger political aspect of the matter, proceeds to say, "it would seem to be almost madness for the English nation to swim against the streams of other countries, countries which protect their profession and industry by means of tariff walls." This is a mere preliminary to "not discussing" the subject, and the lecturer then proceeds at some length to "not enlarge" upon the topic. "It cannot be doubted," says he, "that such tariff walls provide at least one factor safeguarding professional and commercial life, namely, security for employment and an outlet for manufactured commodities." If the students had not previously familiarised themselves with the real facts of the case, they no doubt went home under the impression that in a protected country unemployment was unknown, and that, to put it in the crude fashion of the Protectionist Press, there were two jobs for every man in America, Germany, and other highly protected countries, and that protection had the effect of keeping out other countries' manufactures. Like the lecturer, we do not propose to enlarge on the matter, but, in passing, we should like to tell those students that unemployment is no patented monopoly of this country. A reference to the official bulletin of the New York State Department of Labour shows that America has its unemployment problems not less acutely than we. For instance, in 1907, when the British Trade Unions returned 4·2 per cent. of their members as unemployed, the 92 American unions which made returns showed no less than 34·2 per cent. as unemployed, and 92 per cent. of the unemployment was due to lack of work!

Just to touch upon the other point, and following Mr. Railing's example, to "not enlarge" upon it, and referring to the engineering industries only, we find that so far from tariffs keeping out manufactures, it was shown by the Tariff Commission (which would have liked to prove Mr. Railing's contention) that whereas the imports into this free country amounted to £5,312,000, in 1907 the exports of engineering manufactures amounted to £31,743,000. Even to

highly-protected Germany, we in that year exported engineering manufactures to the value of £2,366,000, whereas Germany sent us less than half this value. We are sorry to have to quote these figures once again, but we presume that in kindly sending us a copy of his address Mr. Railing wished us to comment on it. We think it was hardly fair of him to introduce so much contentious matter into a lecture delivered to students upon "Commercial Engineering," and to give so one-sided a view of the arguments.

With the second portion of the lecture we have more sympathy. In this Mr. Railing advocated the broadening of the basis of technical education to include training in business methods. "It is necessary for the student," said the lecturer, "to make himself acquainted with the rudiments of commercial knowledge, accountancy, business organisation, commercial laws, bank practice, patent laws and so forth." This would, we think, form a fairly liberal training, but it could hardly be acquired in addition to the specialised technical training during the usual three years' course. We gather, however, that this is Mr. Railing's intention when he says these subjects should "be studied whilst they (the students) are undergoing their training, and then is the time to implant a groundwork of commercial knowledge side by side with the technical groundwork." He advocates also that employers should insist that applicants for engineering positions should have passed "certain examinations" which would be "a guarantee that they have acquired a certain standard of knowledge." There are, we know, employers who attach very little importance to examinations, and it is not so long ago that the possession of a University degree was a handicap rather than otherwise in obtaining an engineering appointment; still, we are inclined to agree with Mr. Railing that examination results do form a preliminary guide to a man's theoretical attainments. But commercial training, to be of any use, can only be acquired by actual experience in the business departments of a works, just as real engineering experience can be gained only in actual engineering work, and on this point Mr. Railing says:—"Apprentices should insist, and it is in the interests of their employers to insist, that their apprenticeship should cover not only time spent in technical departments, but also in the commercial departments of the works." We feel sure that very few manufacturers will be found to admit apprentices into their commercial departments, and we would go so far as to say that successful business management would be impossible if the apprenticeship system were to be extended to embrace these departments. It is very unlikely that a manufacturer will allow an apprentice to become acquainted with his particular methods of organisation and of prime costing, and give him opportunities of making copious notes of works cost of dynamos, motors, &c. Such an apprentice, as soon as he was out of his time, would be a valuable acquisition to a rival establishment, and few manufacturers, we think, would be inclined to follow Mr. Railing to this extent.

In adopting Tredgold's definition of an engineer as "a man who directs great sources of power in nature to the use and convenience of man," the lecturer complains that whilst the technical colleges "are taking care that we are getting efficient in a knowledge of the theory and in knowing and directing the sources of power which have been so largely developed during the past century," he thinks little has been done to make use of them for the convenience of man. In other words, the colleges turn out theoretical but not commercial engineers. A commercial engineer, however, should not be merely a sales engineer—the common acceptation of the term—but one who could show a customer not merely that he was buying a cheaper plant than that of a competitor, but that in buying it he was making a good investment. Mr. Railing's definition of a commercial engineer is "a man of trained mind capable of initiative, with a knowledge of the languages and the laws of other countries to enable him to dispose of his manufactures and compete against the trained phalanx of engineers of other nations."

Before leaving the subject, without wishing to raise again the subject of tariffs, or the question of financing great schemes of power transmission—an item which should not be overlooked in discussing foreign competition—we should like to ask if in harping so much on foreign competition, and calling on the Government, as Mr. Railing does in his address, "for guidance towards the roads of prosperity and success," we do not overlook the actual conditions of home competition and price cutting. How is it that with the leading electrical engineering establishments working night and day at full pressure, and with no foreign importation at the moment worth speaking of, there is still the general cry of "cut prices"?

As Mr. Railing truly says, "all is not well." Is the estimating department conducted always on strict business lines, and are the prices quoted based on prime costs, or rather on what it is supposed the other fellow will quote? We fear there is far too much of the latter tendency, which results not only in price-cutting, but quality-cutting also. When the fundamental idea is to get the order at all costs, and then try to make it pay afterwards, rather than basing prices on actual costs and quoting to make a profit, there is bound to be a tendency to cut the work fine, as well as the price, and this policy of first cutting the price and then the quality can have only one result.

In other branches of engineering there appears to be more combination among manufacturers, and we should like to see the electrical manufacturers put their heads together, to ensure that estimates shall at least be based on true cost prices, and shall cover a fair margin of profit on them. There would be just as much work to be had, but there would be better balance-sheets at the end of the year.

Breakdown of Insulating Materials.

As some sort of safeguard against the employment of inherently weak material, and as a check upon the care exerted by the winders, engineers and manufacturers have for many years applied a pressure test of, say, 1,000 or 1,500 volts for a definite interval to the windings of low-tension machines. In high-tension work pressure tests are also employed, but here the ratio of test pressure to working pressure is much lower. Such tests, taken in conjunction with measurements of insulation resistance, are a fair indication as to the condition of the machine at the time of its leaving the works, always remembering that an armature or field coil low in insulation resistance may, through the expulsion of moisture by baking, have a fictitiously high value. This is of little utility where material of a markedly hygroscopic nature is employed.

Thus in tropical countries, with a well-defined rainy season, cases are on record of insulation failures on low-tension machines coinciding with the breaking of the monsoon, fibrous materials having been used. It has long been recognised that high-tension machines are liable to troubles of their own which are independent of climatic conditions. Part of these may be attributable to loss of mechanical properties if fibrous materials become brittle when overheated, while excessive vibration tends to cause a mechanical disintegration of mica insulation. Then, too, abrasion of the windings through faults in construction or design has caused trouble, while a chemical action causing a greenish appearance on the copper conductor is not unknown. Such failures, when occurring in high-voltage machines, form the subject of a paper by Messrs. Fleming and Johnson, recently read before the Manchester Local Section of the Institution of Electrical Engineers, and abstracted elsewhere in this issue.

There is also another class of troubles common in gas-driven generating stations, where both the copper commutator bars and the windings are seriously attacked, and where the one remedy for low-voltage machines seems to be copious and frequent applications of varnish.

The paper by Messrs. Fleming and Johnson is to be commended for its frank discussion of troubles common to the whole industry. The formation of nitric acid in air spaces between the conductor and the insulating material has been considered to be the main source of trouble. For the future we must recognise the fact that through the production of ozone, a decomposition of the varnish will take place with the formation of organic acids capable of attacking the copper. The authors also point out that the filling of the interstices of the insulation is a valuable remedial measure, inasmuch as the inhalation and expiration of air with the alternate cooling and heating of the windings is obviated.

The greening of the conductors in low-tension machines is often found to occur with varnishes which are entirely free from any traces of organic acids. The explanation is probably to be found particularly in the case of field magnet coils in imperfect drying previously to impregnation. Given the presence of small percentages of moisture, and of traces of deliquescent salts in fibrous insulating materials such as leatheroid or bleached cotton coverings, we have here a possible cause for action through electrolysis.

We have still much to investigate in regard to insulating materials. Some engineers now specify limits of hygroscopic susceptibility. In addition to this it is necessary—when we have obtained the requisite knowledge—to regard insulating materials in a manner resembling that in which cement or steel is regarded, namely, to define the requisite dielectric strength, chemical constitution, and tensile strength, the latter both initially and after exposure to high temperatures. Concerted investigation by those interested would be well worth the trouble involved.

Not quite a Competitor yet!

We recorded last week the placing of the contract for the electrical plant for the State coal mine at Wonthaggi (Victoria). The successful tender (£26,648) includes generating plant which will be of British manufacture; there will be two three-crank compound Browett-Lindley engines, and a Curtis low-pressure turbine made at Rugby by the B.T.-H. Co., and as the tenderer, the Australian General Electric Co., also represents the Schenectady General Electric Co., presumably part of the work will go to America. As we have pointed out in another connection, there is a strong desire on the part of some Australians to prevent business of this description going out of the Colony, whether they may be able to manufacture economically and efficiently or no. In this instance a deputation from the Iron Trades Council waited upon the Minister of Mines, urging the adoption of that course in the case of this particular contract. The Minister in question, however, remarked that while the Government was anxious to give preference to local manufactures, it really could not shut its eyes to the fact that the tender of the purely Australian manufacturer was 73 per cent. higher than the lowest estimate from outside. An Australian contemporary reports him as adding :—

> People in the town are waiting for lighting facilities, and other mines are ready to buy electricity from us. I am Australian born, and would like to give preference to Australian manufactures, but I cannot face the difference in the figures as pointed out by the Committee.

Certainly our Australian kinsmen have a long way to go before they can afford to dispense with outside electrical manufacturing assistance, unless they are going to pay fancy prices in order to build up a manufacturing capacity which the market can hardly warrant until general development proceeds at a far greater pace.

THE NEW ELECTRICITY IN MINES RULES.

(*Continued from page* 332.)

Although, as previously mentioned, the number of accidents never reached a higher figure than 1·54 per cent., it must be remembered that had reasonable precautions been taken, even this proportion would have been very much less; but the worst feature was the moral effect upon the minds of uneducated workmen, due to the fact that the cause of many of the accidents could not be explained. Hence, if electricity is not allowed in any part of a mine in which inflammable gas is found, one risk of accident is entirely eliminated; the other class of accident—viz., "electric shock"—can practically be eliminated by the exercise of care in the design and maintenance of the apparatus.

This question is not affected so much by the voltage or "pressure" of the installation, as, to quote the report, "it is generally agreed that even *moderate pressures* under the conditions commonly met with underground may be dangerous to life," and, therefore, it is no excuse to assume that because a low-pressure system is adopted less care may be taken in the selection of suitable apparatus. On the other hand, it is not to be assumed that high-pressure current is or can be rendered as safe or as suitable for many purposes as a "low" pressure, and hence under the new rules motors under 20 H.P. must not be supplied with current above medium or low pressure, and all portable apparatus and the lighting system should be at as low a pressure as possible. The use of three-phase alternating current enables such low pressures to be readily obtained by means of transformers, and on this point the Committee say: "Small transformers for reducing high or medium pressure to low pressure are now obtainable at trifling cost, and there is, therefore, *no reason why* 100 *volts should ever be exceeded* on any new underground lighting installation. In fact, with the much lower current consumption of modern electric lamps, *low pressures such as* 25 *volts* can be used for lighting." We would suggest not only that the lower pressure of 25 volts should be adopted, but that colliery managers would be well advised to alter their present voltage for lighting to this pressure, where conditions are suitable.

Further, "small motors supplied by *low-pressure current* . . . . are both *cheaper* and *more reliable* than motors supplied direct by high or medium pressure current. In the case of *coal-cutter motors*, the severe conditions of working *make the advantages of transforming to low pressures* for use *even more pronounced* than in the case of fixed motors." With this we are in complete agreement, and, as a matter of fact, in all mines where the atmosphere is more or less damp, it will be found that where the pressure is "low," the easier will the "insulation" of the system be maintained, and of course there will be less risk of breakdown and danger of shock.

Motors above 20 H.P. *may* be supplied with current at higher pressures than medium pressure *provided* that the motor *is fixed*, and "in which the high or extra-high-pressure parts are stationary," but the Committee wisely point out that "it should be borne in mind that the higher the voltage the *less satisfactory mechanically* are the windings of small motors. Unless very substantially and carefully constructed, it is not advisable to use motors with a great many small wires per slot, and it is advisable and will probably *pay from a maintenance standpoint* to transform down to lower voltages in many such cases." It is further suggested that where the supply pressure is in the neighbourhood of 3,000 volts it is better to transform down for motors of 50 H.P., and at pressures higher than 3,000 volts to transform down for motors of 100 H.P. and under. Considering all the conditions underground, it cannot be said that the new rules under this head either unduly interfere with the selection by the management, or will in any way tend to retard attempts on the part of manufacturers to improve high-pressure motors and apparatus, but, generally speaking, it will be found that for all motors below 100 H.P., a pressure not higher than medium, and for motors below 20 H.P., a pressure not higher than low pressure will give the best results.

As regards the construction of apparatus for use underground, it was suggested that the Committee should

officially approve certain types and designs, but this they could not accept for reasons which they state, and which will bear repeating :—

1. Official approval of apparatus would *hamper progress*.

2. Approval of *each* individual piece of apparatus would be involved for the *system to work effectively*, for as much depends upon *the way in which the parts of electrical apparatus are fitted together* as upon their design.

3. *Such approval might engender less consideration on the part of the management* of a mine in introducing electricity, and *less care* in maintenance and operation afterwards.

Of these, the third is certainly the most important from a mining point of view, as it is easily seen that by adopting apparatus officially approved, the management would be relieved of all responsibility, and the non-technical manager would be prone to assume that he *could not go wrong*; and as regards the other two reasons every manufacturer will fully endorse the views therein expressed.

Consequently, then, the Committee consider that all the rules require to ensure is (*a*) the proper design, construction and installation of plant, and (*b*) its adequate inspection and maintenance. As to the first, it is pointed out—as has often been pointed out in these columns—that "proper design and good construction and workmanship are *too often absent* from colliery installations, and apparatus is bought on *account of cheapness* rather than on account of quality or suitability . . . . a tendency *the effect of which is augmented by the intense competition* among manufacturers (which) policy is bad for collieries *because it involves heavy maintenance costs* and *introduces unnecessary risks*." All of which is quite true, but it is very questionable whether this difficulty will ever be removed. It is certainly very undesirable that competition should be removed or even lessened, as the keener the competition, the quicker the progress, and it is always a strong temptation to a manager who is anxious to do the best for his employers to accept the lowest tender, and more especially when he is *assured* by the contractor that the work or apparatus *will be perfectly satisfactory*. At the most, as things are, all that can be hoped for is that the colliery manager will appreciate that cheap apparatus is not only very expensive in the long run, but that it increases the risk of breakdown and danger to the workmen under his charge; and that manufacturers will appreciate the fact that a reputation for good work was never obtained by selling cheap jerry-built articles. Every piece of apparatus should be solid and substantial and built on "steam" engineering lines. The conditions under which the piece of apparatus is to be placed and worked must be known and understood, and the design made accordingly. Rule 10 should be carefully read and studied so as thoroughly to grasp the meaning and importance of the several sub-sections.

(*To be continued.*)

METER TESTING IN CENTRAL STATIONS.

By A. T. BULLEN.

The organisation of the staff and their duties is perhaps the most important and yet the most difficult task in the successful development of an electric generating station.

Considerable attention and careful thought have been given to this section of the undertaking by numerous engineers, with the result that in the majority of cases the station is run on economical and yet efficient lines, but the writer has noticed that in a large number of cases there is one weak spot—one which seems to be almost the most important, since it is practically the revenue department—namely, the meter department.

It is surprising to find the neglectful and loose methods employed all over the country in the various meter departments.

Their staffs are rarely well organised, invariably small, and consequently overworked. The test rooms are not as a rule well equipped, and in a good many cases have not a thoroughly capable man in charge.

Sufficient facilities are not given to inspectors for the testing of meters under working conditions. This is often really necessary, as many faults develop in meters which would be revealed while the meter was installed, by a careful examination, and yet which might be almost permanently disturbed by the removal of the meter. This has been the experience of the writer on numerous occasions.

A good number of engineers are not in favour of the system of testing before removal, but this is undoubtedly a mistake.

Further, a systematic inspection of the meters at regular intervals by capable men would often relieve the department of the more serious troubles which develop later. For instance, a consumer will often increase his load without giving a thought to the necessity of informing the supply authority, and this alone has been the cause of many meters being burnt up, whereas, had a regular inspection taken place, the excessive load might have been noted and a larger meter substituted.

The introduction of low candle-power metallic-filament lamps has become a source of great loss to many supply companies, but a large proportion of this loss occurs through the older types of meters being called upon to register small amounts which they are not sensitive enough to record. Surely, here is a case for periodic inspection.

It is not sufficient to rely on the untrained meter readers to report all such failings in meters. Again, it is not an unfrequent occurrence that the metal-filament lamps are installed directly after a meter reading, on the advice of the inspector, and it is then a whole quarter before it is discovered that the meter does not register, say, the exciting current of a transformer, not to mention the consumption of, perhaps, one or two 10-watt lamps.

In the test room there should be a chief tester, who is thoroughly conversant with all the various types of meters in use on the circuit. He should be a technically trained man, and a good mechanic, preferably with works experience in testing. He should also be able regularly to check all the instruments under his care. The writer was once in a test room where three wattmeters, connected up in the same circuit, showed variations in their readings to the extent of 9 per cent. The tester in charge could hardly believe his eyes, and, furthermore, was in a quandary as to which instrument he was to use for his testing. When it was suggested that he should check them up singly against some reliable standard, he admitted that he had no such thing, and even if he had he would be uncertain as to the method of procedure.

Another tester was in the habit of checking his instruments against new meters which had just arrived from the makers. Manufacturers of electric meters are, however, gradually dropping the system of sending out certificates with meters, which fact must place that tester in rather an awkward position : and again, it is hardly logic to check the instruments by the meters and then to check the meters by the same instruments.

A well-equipped test room should have not only working instruments of various ranges, but also standard instruments for checking the working instruments. These standard instruments should be recalibrated at least once a year at some instrument works, the National Physical Laboratory, or Faraday House.

The writer would, however, much prefer to see in the test room a set of standard meters which would be checked by the instruments every morning; the actual calibration of the meters would then be carried out by running them with the standard meters. This method is used with a large measure of success in American test rooms, and has many points in its favour. The standard meters, for instance, need not be absolutely correct so long as their exact percentage errors are known. Less experienced men who could hardly be trusted with extremely sensitive instruments, may be employed as assistants, while many mishaps, such as short-circuits, which may permanently upset a delicate instrument, would not affect an ordinary recording meter. There is one disadvantage, however, since the meters in use in most supply systems are not all of one type, and consequently do not run at the same speeds for the respective sizes, but where time tests only are the order, the advisa-

bility of the method is not disputed. Testing by the direct use of the instruments necessitates the use also of an accurate stop-watch, which should occasionally be checked against a metre pendulum. For testing *in situ* suitable portable instruments must be provided which should be handled with care.

The chief tester should leave the test room on rare and important occasions only, the outside work being entrusted to juniors, whose number should vary according to the number of consumers. The junior testers might be made to assist in the quarterly meter readings, but there should be a sufficient number of readers to cope with the work during the rest of the quarter.

A careful record of all meters, both in the test room and on circuit, must be kept, and should be arranged by the chief tester in such a way as to harmonise with the other clerical work of the undertaking.

The salaries paid to meter officials should be sufficient to ensure the securing and keeping of good men only. It often happens that a competent man may be secured at a ridiculously low figure, but he will not remain at that figure if he is worth more, and his place might then be filled with just the opposite kind of man, not to mention the great inconvenience of continual changes in the staff.

Many stations have to put up with a very moderate tester because up to the present few engineers have realised that money spent in this direction is usually well repaid. The time is, however, not far distant when the reorganisation of many of the more neglected of these meter departments will be an accomplished fact, for one notices that manufacturers of electric meters are beginning to employ men to visit the various supply circuits for the purpose of examining meters under working conditions, and also to carry out tests at the stations.

Although this will tend to reduce the work of the supply authorities' testers, it will not do away with the necessity of these important people; rather will it call for better men to ensure that the manufacturers do not have to send their men on foolish errands, which would entail a heavy and useless expenditure on their part, or on the part of the supply company.

In conclusion, the writer feels that it is necessary to give a passing thought to the various testing panels, transformers, &c., which are now being placed on the market to facilitate the testing of meters, all of which are in themselves excellent additions to most test rooms; but, at the same time, the fact must not be lost sight of that the majority of troubles that arise in electric meters are mechanical, and very often the slight advantages to be gained by the use of such improvements as those above mentioned do not warrant the expenditure of large sums of money on their purchase.

WORKS v. ACCOUNTANT'S DEPARTMENT.

By "INTERESTED."

That big question—the advisability of electricity supply works keeping the whole of their accounts at the station—is one upon which opinion is so clearly and evenly divided that for me, a mere works man, to reiterate "our" views on the subject here would be only once again covering very old ground. That is not my intention. In those undertakings where the accounts of the electricity department are handled at the Town Hall, a certain amount of duplication in the work is unavoidable, and friction, more or less acute, between the various officials is sure to continue. All very well to say why not work in one with another, but somehow trifling matters are magnified many times, and these enlarged trifles very often show up in the form of trouble. Peculiarly enough the magnifier usually is to be found at the Town Hall. Just why this should be I shall not venture to say: all the same the fact remains, friction does often occur, and the base of operations is frequently at the Town Hall.

Name of street .....

No. of house.	Units at 5d.	Units at 3d.	Units at 1½d.	Units at 1d.	Other rates.	Discount.

Fig. 2.

In this short article I do not propose to continue harping on the sore part of this question, but will refer more particularly to the other side by giving one or two illustrations for carrying out certain work between the two offices in such a manner as tends toward more amicable relations one with another.

Perhaps the major portion of the disagreement arises from the necessary work in connection with consumers' accounts. Usually the station staff works out the many accounts from the readings brought in by the meter inspectors, and forwards them to the accountant's office for the purpose of that staff's sending out invoices and collecting the money. At the works, cards are used in place of a book, ruled and printed something like the following (fig. 1):—

Name..... Address..... No.....

Date.	Meter reading.	Units at 5d. £ s. d.	Other rates. £ s. d.	Total. £ s. d.	Date.	Meter reading.	Units at 5d. £ s. d.	Other rates. £ s. d.	Total. £ s. d.

Fig. 1.

Whenever necessary, weekly, monthly, or quarterly, particulars are entered on these cards, and the charges calculated and extended in the proper columns. They are then locked (by means of a rod which passes through holes in the bottom of the cards) in a drawer taken from a card cabinet, and sent over to the accountant for his staff to render the

Quarter ending.....19 Letter.....

Name of street.	Units at 5d.	Units at 3d.	Units at 1½d.	Other rates.	Discount.	Totals. 1910 | 1911

Fig. 3.

invoices. This arrangement ensures full particulars of the account being at hand for the disposal of the staff of the financial department, and likewise clears the works staff from blame in the event of errors occurring in the invoices sent out.

Quarter ending.....19

Letter.	Units at 5d.	Units at 3d.	Units at 1½d.	Other rates.	Discount.	Totals. 1910 | 1911

Fig. 4.

The next step is the balancing of the two departments' figures regarding the number of units sold and the value of the same at the end of each quarter. In order to secure an accurate return of all figures forwarded to the Town Hall, details

from the above-mentioned cards are entered on the sheets shown in figs. 2, 3 and 4, before they (the cards) leave the works. These sheets are bound in loose-leaf covers for the sake of convenience.

The illustrations almost explain themselves. Fig. 2 has the name of a street or road entered at the top, and the respective numbers of consumers' premises are entered in the first side column in numerical order. This job can be done previously to the commencement of each meter reading. Any additional consumers connected after the numbers are filled in can be inserted at the end of the list and arranged in proper order when preparing the sheet for the following quarter. Fig. 3 forms a summary of the fig. 2 lists. One sheet is given to each letter of the alphabet, and all the roads are entered under each letter, so that the totals of these give particulars of all energy sold in each batch of roads, commencing with any particular letter. Fig. 4 is a further summary showing the total number of units sold at the various rates, interest allowed, &c., and forms a complete statement of energy sold to private consumers, quarter by quarter. In figs. 3 and 4 a column is included for last year's totals, so that a comparison of the two sets of figures can be seen without undue trouble. Weekly and monthly accounts are entered on their respective sheets from time to time as they are sent over to the accountant, in order to ensure a complete total at the end of the quarter.

By keeping records in this manner at the works, one is enabled to find sectional totals, which are a help when trying to balance figures every three months. At the same time an eye is kept on the consumption of each district, and affords an indication of any rise or fall in any particular road or district. The idea of the accountant having the whole account before him when making out the demands for payment is worth the trouble, as many little slips are by this means averted.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment No letter can be published unless we have the writer's name and address in our possession.

Live-Steam Feed-Water Heating.

In spite of the most convincing proofs of the saving effected by live-steam feed heating, there are still a large number of engineers who absolutely refuse to accept the fact, simply because they contend that to take heat from the steam and give it to the feed water is merely robbing Peter to pay Paul, and, consequently, no economy can be effected. In view of Mr. John I. Hall's vehement and somewhat bigoted assertions to this effect, will you allow me to place a few facts before your readers that, to my mind, fully explain the matter.

In the year 1872 Mr. W. Anderson demonstrated before the Institution of Civil Engineers the fact that when a vessel of water is heated, the vessel is capable of passing more heat units per unit of time to the water when the water is at the temperature of evaporation than when merely heating the water. In his experiments he showed that the quantity of heat passed through the metal vessel per square foot per degree per hour was 260 units when only heating the water, whereas it was 606 units when the water was evaporating. Sir Frederick Bramwell at the same meeting gave data of independent tests which fully substantiated Mr. Anderson's results.

Now these were only laboratory tests, but they give the key to the whole discussion about feed-water heating:—When water is fed into a boiler at the temperature of evaporation, the heating surface of the boiler is capable of transmitting a far greater number of thermal units than if it had first to raise the water to the temperature of vaporisation, with the result that a large percentage of the heat that would otherwise be swept into the flues and dissipated up the chimney is absorbed through the heating surface of the boiler, and in this way one of the most serious boiler-house losses is greatly minimised.

The experiments of Mr. Anderson and Sir F. Bramwell were quoted by Mr. Hamilton in his excellent paper before the Belfast Mechanical and Engineering Association, in 1902, and, so far as I am aware, Mr. Hamilton was the first to appreciate the significance of the experiments. One other beneficial result of live-steam feed-water heating is the more violent scrubbing action that obtains over the whole of the heating surface. I do not intend to enlarge upon the benefit of this scrubbing action, but I would suggest that there is still in this respect a field for useful work in perfecting some mechanical means of accelerating water circulation in steam boilers. This artificial scrubbing has been tried in the States, but failed, I believe, due to mechanical defects.

For a number of years there has been continual disagreement on this question of feed-water heating; tests innumerable have been advanced and proved to be valueless, data taken in most carefully conducted tests have been published, picked to pieces and thrown to the winds, and in the end we have to fall back upon a mere crude unscientific fact such as that given in the Editorial article in your issue of March 3rd, namely, that live-steam-feeding steamers saved 5 per cent. of fuel on the round trip to China and back.

W. S. Burge.

Newcastle-on-Tyne, *March 6th*, 1911.

Simple Pendant Fittings.

I have searched some dozen catalogues for an electric light fitting with a silk flounce suspended from a simple brass band or collar, and find they are listed the same in every catalogue, starting at 50s. upwards.

I claim that a fitting that would look equally well (three-light) could be made and listed at 30s. The necessity for this fitting is due to the metal lamp, as per appended list of advantages.

A counterweight is not necessary or desirable; if the fitting were made *light*, it could be suspended by flexible.

ADVANTAGES.

1. Osram lamps do not lend themselves to glass shades to the extent that carbon lamps did.
2. Eye does not see naked lamp.
3. Looks O.K. with one or two lamps alight and one lamp out, while a three-light fitting with one lamp alight looks like a cow with one horn.
4. Does not "draw down" ceiling—throws light equally up and down.
5. To get the advantages of reflection off ceiling (as with inverted arc lamp). Again, in some richly-furnished rooms the ceiling is the only place one can get much reflection from.
6. Can plug in table lamp (see advantage No. 3).
7. Looks equally well, whether one, two or three lamps alight.
8. Silk shade can be washed, removed, repaired, replaced. Only one thing cannot be done with it—that is to break it, which proves so awkward when one has to match glass shades.
9. Shade at a distance from light, so does not cut it down to same extent as glass shade *close* up to it.
10. Good air circulation around lamp. The Osram shades bottle up the lamps too much.
11. Fitting can be raised by the chain, and suspended from ceiling hook; this is an advantage for spring cleaning, when fittings and globes get damaged.
12. It is simple and cheap to make, small to pack, will not get broken in carriage, and is easy to erect.

Supply.

Electric Cooking.

With reference to Mr. Morgan's remarks and the letter from "Interested" on this subject, I do not think that engineers of supply companies will have any reason to worry for some time to come about their distributing systems being overloaded owing to electric cooking appliances. Electrical domestic utensils are still too costly for any but the well-to-do. Why cannot some manufacturer supply some simple heating unit that can be fitted on any ordinary oven?

It seems to me particularly unfortunate that gas supply companies should have so long obtained just those long-hour loads that are peculiarly suited to electrical supply—such as street lighting, cooking and heating—whilst we have had to be satisfied with supplying the better-class shops that close early, large houses whose owners close them for long periods in the summer, lifts and motor-driven machinery of that description that have high peak loads and do not use much current, and the like.

Fortunately electricity is being supplied cheaply now by systems of charging that anyone can understand, and the next few years will see great developments.

W. A. Toppin.

March 4th, 1911.

All-British Manufactures.

Having regard to the agitation that is now going on in commercial circles as to traders dealing exclusively with British manufacturers, it has occurred to me that possibly some understanding might be arrived at on similar lines, between electrical contractors who act as retailers and the British manufacturers.

I, for my part, would be prepared to pledge my firm to deal entirely with British manufacturers for some articles, if they on their side would be prepared to meet me, so that I could compete against those who continually buy foreign-made goods.

W. R. Rawlings.

London, S.W., *March 3rd*, 1911.

"Voltmeter."—A reply has been forwarded by post.

PARLIAMENTARY.

Metropolitan District Railway Bill.

A Select Committee, presided over by Mr. Guinness, on Tuesday commenced the consideration of the Metropolitan District Railway Bill. Mr. J. D. Fitzgerald, K.C., with Mr. H. Lloyd, K.C., Mr. Roskill, K.C., and Mr. L. Maccassey appeared for the promoters. Mr. Balfour Browne, K.C., and Mr. Tyldesley Jones represented the Metropolitan Electric Supply Co., and there were also petitions by the Croydon Corporation, the Westminster Electric Supply Corporation, Islington Borough Council, the companies supplying electricity in the County of London, the North Metropolitan Electric Power Co., and others.

Mr. Fitzgerald said the main object of the Bill was to incorporate a joint committee of the Metropolitan District Railway Co., and the London Electric Railway Co., and to authorise that committee to purchase the power house at Lot's Road, Chelsea, and lease the same to the two railway companies. The power house at Lot's Road, Chelsea, was the power house from which the two railway companies at the present time derived their supply of electricity. A very large number of petitions had been presented against the Bill, but, as a result of negotiations, they had come to terms with many of the petitioners. The London Electric Railway Co., which was the other company associated with the Metropolitan District, was formed by the amalgamation of the Baker Street and Waterloo, the Charing Cross, Euston and Hampstead, and the Great Northern, Piccadilly and Brompton Railways. The power house was owned now by what was known as the Underground Electric Co., which was a limited company, whilst the two railway companies were statutory companies, incorporated by Parliament. The power house was one of the finest not only in London but in the world, and had been built and equipped at an expense of close on £1,500,000, whilst at present there were being installed eight new Parsons turbines. Under the agreement which existed at the present time between the two railway companies and the Underground Co., the railway companies had agreed for a term of 99 years to take the electricity required for working their lines from Lot's Road, and to pay for it by monthly instalments equivalent to the following sums:—To 5 per cent. on the cost of the generating station; to the expense of working, repairs, depreciation, and so forth in connection with the generating station; and to a small profit over and above. Consequently, it would be seen that the railway companies obtained their electricity at cost price, plus a small profit.

The Chairman: Do the two railway companies take the whole of the output from Lots Road?

Mr. Fitzgerald said they were giving a supply to the Tilbury and Southend Railway and the London and South-Western Railway, and they had power at present to supply to a number of other railway companies. At present the Underground Co., the Metropolitan District, and the London Electric Railway Companies were in close alliance and their interests were identical. The Underground Co. provided the capital necessary to convert the District Railway from steam working to electricity, and they also provided the greater portion of the capital for the construction and equipment of the three tube railways now amalgamated into the London Electric Railway, and accordingly, in addition to the money they had sunk in the power station, they were large stock-holders in the Metropolitan District Railway and were the owners of the greater portion of the capital of the London Electric Railway. Consequently, at present their interests were identical and there was no friction of any sort; but obviously that state of things might not always continue. The Underground Co. was a limited company, and it might become to their interest, and probably would, to sell their holdings in the tube railways when they paid substantial dividends, and they might also wish to sell the power house to some other company, and wind themselves up and divide the purchase-money. If such a thing were to take place a very unfortunate position might arise, because a new company might be unwilling to spend further money in improved machinery for the more economical working of the power house and matters of that sort. But whilst the power house was owned by the Underground Co. all the sub-stations and the cables were owned by the two railway companies, and represented an investment of £800,000. Under these circumstances, and at a moment when the interests were identical, it seemed a sound policy that the railway companies should become the owners of the power house, on which the economical working of their railways and the public convenience so largely depended. Accordingly, arrangements had been made for that purpose, and the requisite machinery, although complex in appearance, would in reality be very simple. It was proposed by the Bill to incorporate a joint committee, to be composed of three directors of each company, and to appoint a standing arbitrator in cases of difficulty arising between the two companies. The joint committee having been appointed, then by Clause 9 they obtained power to purchase the generating station.

(*To be continued.*)

LEGAL.

The London Electric Supply Corporation, Ltd., *v.* The Westminster Electric Supply Corporation, Ltd.

In the Chancery Division this action, which was brought on an agreement between the two companies as to the supply of electricity in the City of Westminster, was opened on Wednesday, March 1st, before Mr. Justice Joyce.

Mr. Gore Browne, representing the plaintiffs, said that this was an action which in substance asked his Lordship to interpret the agreement between the plaintiffs and defendants. It asked for an injunction to restrain the defendants from acting in breach of the agreement, and for a declaration on the true construction of certain parts of it. The plaintiff company—the London Electric Supply Corporation, Ltd.—was constituted under a Provisional Order (1889) to supply electricity over a very large area in London, which included, amongst other places, the borough of Westminster: but the present action was only concerned with Westminster. The defendant corporation was in the same year constituted to supply electricity in Westminster, and both of the companies shortly afterwards commenced doing business. There was, however, this distinction between them. The plaintiff company supplied in effect alternating current, whereas the defendant company supplied direct current to their customers. Originally the plaintiff company could only supply alternating current, in order to comply with the requirements of the Board of Trade; but in the year 1905 they obtained the approval of the Board of Trade to both systems, so that they could supply either system at their own option. They did, in fact, however continue almost solely in Westminster to supply the alternating system. In the year 1908 there was a considerable movement towards the use of metallic-filament lamps, which was followed by a demand on the supply of the London company instead of on the Westminster company. Lamps of 32 candle-power came into use, but it was an expense to put them in, and with the direct-current they were short-lived, and there was a tendency to change over from the Westminster company to the London company, so as to get the alternating current, which could be transformed to 100 volts, or even as low as 50. In the provisional order of the Board of Trade there was a clause that the London company should not sell or dispose of their concession to any other company, and down to 1908 it remained obligatory upon these two companies, not to come to any arrangement for association together, but in 1908 an Act of Parliament was passed expressly enabling them to enter into agreements for association and mutual assistance, and in pursuance of that Act of Parliament, an agreement was entered into, upon which the present action was based. It was, however, an agreement that was not to become operative until the approval of the Board of Trade had been obtained. If the Board of Trade had had any doubt that the rights of the customers of either company would be affected, no doubt they would have thrown it out. The parties knew, therefore, that they had not any such agreement, and both knew well that even if by straining the words in the Act, they could bring such an agreement within it, it would not pass the Board of Trade. They did not, therefore, purport to make any amalgamation agreement, but they made an agreement by which the Westminster company should become managers of the business. The substance of the terms of it was that the Westminster company should manage and do all the distribution for the London company, collect the receipts from the customers, and retain those receipts, subject to a payment over to the London company of three-fourths of the amount that the London company had collected during the last preceding year. That, therefore, was to be a fixed sum. The Westminster company were to supply alternating current to the customers of the London company, but they were to take what was

necessary for carrying on the London company's business from the London company, and were to pay for it at the rate of '85d. per unit. In addition to that, the Westminster company were to pay £2,000 a year towards the costs of maintaining the mains and workings, and another provision which was set out in the statement of claim provided that, when the time came for purchasing the works of the London company, which was in 1931, the Westminster company guaranteed that the purchase price should be not less than £100,000. In other words, the London Electric Supply Corporation were to sell their undertaking in 1931, and if they received less than £100,000, the Westminster company were to make up the sum to £100,000. That agreement was negotiated in the early part of 1909, and took form in the middle of that year. It was submitted to the Board of Trade, and by their instructions to the London County Council. There was some opposition by the L.C.C., but ultimately the agreements were exchanged on May 4th, 1910, and were to take effect on July 10th. The London company had loyally carried out their part of the bargain, but the Westminster Corporation set themselves at once to destroy the business which they had undertaken to support. They began in a way that was not obviously wrong. Where they were supplying direct current to customers for power—and there was no doubt the direct current was more useful for lifts and the like—they commenced to make a change. Both companies supplied current at as low as 1d. per unit where persons were taking continuous current, but the people took, as a rule, the Westminster's supply for their lifts, &c., and the London company's supply for lighting their houses. The first step that the Westminster company took was to serve their customers taking the continuous supply with notice that they proposed to avail themselves of certain powers which enabled them to make a minimum charge. The result of that was in some cases to raise the charge from 1d. to 1s. per unit. They attempted to justify that by saying that they had done the same thing to a small extent before the agreement was made. Then they carried things further, and approached individual customers and invited them to change over, offering them specific benefits for changing. Then when a new customer came along and asked for the London company's system, the Westminster company threw every difficulty in his way. They put it to the customer that he must bear an expense that would make it impossible for him to take the supply. In October, 1910, they went a step further, and set up a positive claim to the right to accept no new customers for the alternating current. They justified that by saying:—"You, the London company, are now entitled to supply either alternating or continuous current, and it is for you to supply whichever your customer selects, but you can't supply continuous current through your mains, so we will supply it ourselves."

The agreement entered into between the two companies on May 4th, 1910, agreed that "as from June 30th, 1909, the London company shall place the management and working of that portion of the London company's undertaking, which is situate within the Westminster area in the hands of the Westminster company during the continuance of this agreement." The London company at its own cost had to keep in efficient working order and repair the transforming stations and works in the London company's undertaking to the reasonable satisfaction of the engineer of the Westminster company. The London company were, at the request of the Westminster company, to do all work and provide all materials as may be required for connecting and disconnecting consumers to or from mains. Clause 9 read—

"The Westminster company shall during the continuance of this agreement read the meters of the consumers of the London company within the Westminster area, and shall render and collect all accounts in respect of electrical energy consumed by such consumers and retain the accounts thus collected for their own use and benefit, and for the purpose of enforcing such collection the Westminster company may make use of the name of the London company so far as the circumstances may require, but any expense connected with such collection shall be borne by the Westminster company."

Either company was to be entitled to purchase from the other such current as it might require, and Clause 14 provided—

"The supply to be given by the London company to the Westminster company under this agreement shall be given at the consumers' terminals, but the Westminster company may require such supply to be given in bulk instead of at the consumers' terminals, and if such requirement shall be made by the Westminster company the amount of energy supplied shall for the purpose of ascertaining the price payable under Clause 17 of these presents be ascertained at the transforming or distributing station of the London company instead of at the consumers' meters, and shall be measured at a pressure of 2,500 volts."

Clause 15, said counsel, was an important one:—

"The Westminster company shall pay to the London company in each year, until August 26th, 1931, a sum equal to 75 per cent. of the gross amounts received by the London company from their consumers in the Westminster area for the year 1908, and if the statutory purchasing authority do not purchase the undertaking of the London company in the year 1931, then the Westminster company shall pay the London company in each year thereafter until purchase the sum of £4,000, and such sum shall be paid by quarterly instalments . . . . . The first of such quarterly payments shall be made on May 26th, 1910, and shall be reckoned as the payment due to the London company for supply to their consumers during the then preceding quarter. All accounts due and accruing due from such consumers previous to such quarter shall be collected by, or be paid to, the London company, and all accounts of such consumers due for such quarter and all subsequent quarters shall be collected by, or be paid to, the Westminster company . . . . . Any expenses incurred by the Westminster company in this respect shall be refunded to them by the London company."

The Westminster company had also to pay to the London company the sum of £2,000 per annum to meet the standing charges for the maintenance of the works then to be placed in the hands of the Westminster company, and a sum of 85 one-hundredths of 1d. for each Board of Trade unit of electrical energy supplied. Counsel, continuing, said the object of the agreement was mutual association and assistance, and this was to be worked by means of the arrangement for management. It was the intention of the Act and the agreement to allow the customer to go to either corporation for their light.

Mr. Younger said there were very many areas where there was only one supply.

Mr. Gore-Browne: It was the intention of the authorities to preserve public competition as far as they could.

Replying to his Lordship, Counsel said the London County Council had rather conflicting interests, because they were looking after the interests of the public at present, but they wanted to buy the undertakings as cheaply as possible in 1931.

Mr. Gore-Browne read a number of letters to prove his contention that attempts had been made by the Westminster company to obtain the customers of the London company, and maintained that the latter were entitled to maintain their customers, and they were entitled to get new customers without the defendants' interference or seeking to turn them over to themselves. When an inquiry was made as to the London company's system, the defendants, as the agents for the plaintiffs, should give the inquirer an opportunity of becoming a customer of the London company. The defendants could not purchase the plaintiffs' business. That was not allowed, and if it had been possibly the plaintiffs might have been willing to sell, but the two companies were allowed to entrust the management to one man.

His Lordship: The managers could not be dismissed?

Mr. Gore-Browne: No; the employment was up to the date of the sale in 1931, but, subject to damages, any contract could be determined.

Counsel continued that the plaintiffs only asked that the defendants should continue their business as it was. They did not ask them to expend any money in extending it, but to keep it as it was. The plaintiffs had made no efforts to get new customers within the area.

His Lordship: Is not that your true remedy?

Mr. Gore-Browne: No; because they may refuse to supply the current.

Mr. Younger: The alternating supply. That is the point.

Mr. Austen Cartmell followed on the same side, and this concluded the case for the plaintiffs.

On Thursday, March 2nd, Mr. Younger, K.C., outlined the defence. The defendant company denied that the plaintiff company's current was more suited for lighting purposes than that of the defendant company. They said the company's current could not be economically and efficiently used for power purposes as alleged. The defendants set out Paragraph 16 of the agreement, which said that the amount received by the London company from the statutory purchasing authority as the purchase price of their undertaking shall be retained by, and shall be the property of, the London company, and if the amount received by the London company shall be less than the sum of £100,000, after deducting such sum as shall represent the purchase money for property not included in the London company's undertaking as defined in this agreement, then the Westminster company shall forthwith pay such sum as will make up the sum of £100,000. Any question which shall arise under this clause between the parties as to the sum (if any) payable by the Westminster company shall in default of agreement be settled by arbitration under Clause 21 hereof. In the event of any portion of the London company's undertaking ceasing to be required for the purposes of the business, the London company shall, at the request of the Westminster company, take steps to dispose of the same to the best advantage.

The defendants said that for several years previous to 1909 they had supplied current for power purposes at the rate of 1d. per unit. In or about that year the increasing use by the defendant company's customers of metallic-filament lamps, so diminished the defendant company's revenue as to make it impossible to supply current for power remuneratively at that rate, unless a supply for lighting purposes was taken as well. Accordingly, in February, 1909, more than a year before the date of the agreement, the charge for power was raised for all consumers who, after that date, were connected for power only, and also for consumers who having previously taken both light and power from the defendant company, changed over and took their light from the plaintiff company. In the year 1910 a circular was issued to consumers connected before February, 1909, who used the defendant company's current for power only, announcing that the defendant company could not continue to supply them at the old rate unless they took current for lighting also. Such consumers included those who used gas as an illuminant, or had private installations, as well as those who took current from the plaintiff company for lighting purposes. In order to avail themselves of the cheaper rate for power, a certain number of the consumers gave up their old illuminating systems, and took current for light from the defendant company, and their number included a few who formerly took current for light from the plaintiff company. Defendants denied that they owed any duty to the plaintiff company, or that they had in any way acted in breach of the agreement.

Mr. Younger said his contention was this: That this agreement between the plaintiffs and the defendants imposed upon the defendants no duty beyond this, that in the conduct as managers of the plaintiffs' undertaking in the Westminster area they would

comply with all the statutory obligations imposed for the time being. Beyond this there was no obligation except as to the payments which they were bound to make. If the defendants did commit a breach, the plaintiffs' remedy was under Clause 11 by indemnity. Counsel submitted that the whole object of this agreement was to take the fullest advantage of the privileges conferred by the statute, so as to bring about, as far as possible, the unification of the supply of electricity at Westminster. The Westminster company were to carry on the business for their benefit, and they were bound to indemnify the plaintiffs for failure to comply with the conditions imposed upon them. Up to 1931, said counsel, the Westminster company had to pay to the London company a sum equal to 75 per cent. of the gross receipts by the London company for the year 1908, which they now knew was £22,175 per annum. This was the consideration for what the Westminster company took over. Then, in 1931, if the London company's undertaking was not purchased for the sum of £100,000, the Westminster company had to pay them 4 per cent. on that amount until the purchase. The London company either got £100,000 in 1931 or 4 per cent. on £100,000 until they did get it. In the first part of the case the only ground upon which any claim was made—that was the fiduciary duty of a manager to his principals—passed away. Coming to the second part of the case, counsel pointed out that the Westminster company had to pay ·85d. per unit for all power they took from the London company, plus all the charges. They actually had to pay more than it cost them to produce.

Counsel had not concluded when the hearing was adjourned until Wednesday, March 8th.

Reorganisation and Control &c., Co., *v.* The International Motor Traffic Syndicate, Ltd.

Mr. Justice Neville, in the Chancery Division on Monday, heard the motion by the plaintiff syndicate by which they asked to have the action reheard so far as it related to their claim against the first defendants.

Mr. Jenkins, K.C., and Mr. Ward Coldridge appeared for the plaintiffs, and Mr. Gore-Browne, K.C., and Mr. Austen Cartmell represented the defendants.

Mr. Jenkins said that the action so far as it related to the Brighton, Hove and Preston Omnibus Co., Ltd., was dismissed with costs, and that judgment the plaintiffs did not wish to upset. As against the first-named defendants, the International Traffic Syndicate, an inquiry was directed as to the eight omnibuses sold by them to the Brighton Co., costs of the inquiry being reserved and an account of what was due to the defendants under an agreement of January 1st, 1910, the defendants to be at liberty to make such claim to £800 located on the agreement as purchase money, as they might be advised. No order was made as to the costs of the action up to judgment, and subsequent costs were reserved. He was now asking his Lordship to rehear the action on the ground that since the trial certain things had come to the knowledge of the plaintiffs which, unless some explanation was forthcoming, showed that Dr. Lehwess stated in the witness-box that which he must have known to be untrue. His Lordship would remember that the matter turned upon an agreement by which the plaintiff syndicate in consideration of £1,000 and certain fully-paid shares, took over assets of the London Electrobus Co., which included 22 omnibuses and certain spare parts. There was an agreement by which the defendant syndicate found the £1,000, and in satisfaction of £800 they took eight omnibuses, to be selected by the secretary of the plaintiff syndicate, and certain spare parts. The result of the judgment was to make the defendant syndicate mortgagees for any sum that might be due to them on the assets taken over from the London Electrobus Co., which included the eight omnibuses in question and certain spare parts. His Lordship had thought that there was little substance in the inquiry as to damages so far as it related to the eight omnibuses, and the accessories were of no value at all. There were certain accumulators sold to the Brighton Co. for £1,900, but Mr. Riding, called for the plaintiffs, stated that these were the property of the Tudor Accumulator Co., and were merely in possession of the Electrobus Co. under a hiring agreement. This view was confirmed by Dr. Lehwess in his evidence, and on his being asked in cross-examination as to £337 10s. paid to the Tudor Syndicate, he explained that that was paid for replating the accumulators when it was proposed to start another London service. That service, however, was never started, and the Tudor Co. did nothing for the money. Mr. Riding found that he had made a mistake and spoke to Dr. Lehwess on the matter, who said that it would be put right later. It turned out that the £337 10s. was paid to the Tudor Co. in full satisfaction of all claims they had against the Electrobus Co. in respect of seven accumulators agreed to be sold for £1,050, and a further 15 agreed to be sold at £160 a piece were paid for at the full amount of £2,400. It was of those accumulators that 19 were sold to the Brighton Co. for £1,900.

For the defendant company Mr. Gore-Browne read an affidavit by Dr. Lehwess, in which he stated that the matter was not called to his attention until the evening of Friday, February 10th, when the evidence was closed, and he not think it would matter as everything would come out at the inquiry that would be directed. Mr. Riding, in an affidavit, also stated that nothing was said to him when giving a proof of his evidence, about accumulators. The matter was sprung upon him in the witness-box and he made a mistake. Dr. Lehwess following fell into the same error.

His Lordship said he would extend the scope of the inquiry so as to include these accumulators, and ordered the defendant syndicate to pay the costs of the motion and the costs of the application for leave to make it.

Andrews *v.* Abertillery D.C.

In the Chancery Division on Thursday and Friday last week, Mr. Justice Warrington tried an action in which plaintiff sought a declaration that the defendants were not entitled to place electric standards on his land at Llanhilleth, Monmouthshire.

Mr. Clanson, K.C., and Mr. Bethune appeared for the plaintiff, and Mr. Cave, K.C., M.P., and Mr. Church for the defendants.

In opening the case, Mr. Clanson said the action arose from the erection of certain electric standards to carry electric wires immediately in front of some houses belonging to the plaintiff. The defendants were in possession of a provisional order of the usual type authorising them to supply electricity. They had put up massive structures carrying eight wires, which formed the mains that conveyed the whole of the electric power through this portion of the district. Three standards had been put up, each of them double poles which came together at the top, but which were a very serious obstruction to the footpath. They obstructed the entrance to the plaintiff's hotel, the Royal Oak. For the purpose of erecting those standards, the defendants found it necessary to dig deep holes. As regarded one hole, the digging involved the cutting away of the wall at the hotel, and as regarded the other two, they dug deep excavations into which the water flowed, and considerable damage ensued. He submitted that the defendants had no power under their provisional order to put up overhead wires on land which was not a part of the highway. He admitted he could not have interfered with them if they had laid down their distributing mains in that portion of the street which was repairable by the inhabitants at large and which was the highway. The question between the parties not only related to the standards, but had to do with the wires as well, and he contended that the wires were not above any area which under the Public Health Act would be vested in the local authority.

Mr. Cave, for the defendants, contended that under their statutory powers the Council were enabled to put the standards on the footpath, which, he said, was a public footpath although not repairable by the public. It was thrown into the road and intended to be part of the road. The defendants took the view that the standards were a necessary part of the electric lighting system of the locality and necessary for the public benefit. If plaintiff should succeed in the action, he would make the lighting of this part of the district absolutely impossible.

His Lordship, in giving judgment, held that the strip of pavement in front of the Royal Oak was not a public highway repairable by the inhabitants at large. It had never been acquired by the local authority, and one of the standards complained of was erected on land not vested in them. He held that the defendants were authorised to put their mains above ground, and that the only question he had to determine was whether they were entitled to use this piece of street not vested in them. He thought it would be absurd to place upon the Council the obligation of laying down a continuous main in a street and yet make it impossible for them to make use for that purpose of a bit of a street not vested in them. He found that no nuisance had been proved in this case, and that if there was a nuisance the plaintiff's true remedy was to seek compensation under the Lands Clauses Act, 1845. The plaintiff entirely failed, and there must be judgment for the defendants, with costs.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Locking Lampholder.

We have received a sample of the "Kingolite" patent locking lampholder, in which the two small horizontal plungers which, as described in our issue of February 10th, hold the various sections of this holder together, are further utilised to automatically lock the

Fig. 1.—"Kingolite" Locking Lampholder.

sections of the "locking" holder when a lamp is inserted and turned in the socket, in such a manner that the lamp cannot be withdrawn, except by using a key provided.

The key consists merely of a bent strip of spring steel, the ends of which can be sprung into slots in a hood over the holder, and used to depress the plungers, when the lamp can be turned in the socket and withdrawn in the usual way. The "Kingolite" Co., 120, Wardour Street, W., has recently issued a price list of these holders.

Mining Motor.

The Phœnix Dynamo Manufacturing Co., Ltd., of Bradford, have on the market a special mining motor, designed particularly to meet the conditions obtaining in underground work, and claimed, as the result of careful tests, to be explosion-proof.

These machines are liberally rated, and will give 50 per cent. overload without injurious sparking; ball or roller bearings of a special dustproof type are fitted, capable of a three months' run without attention.

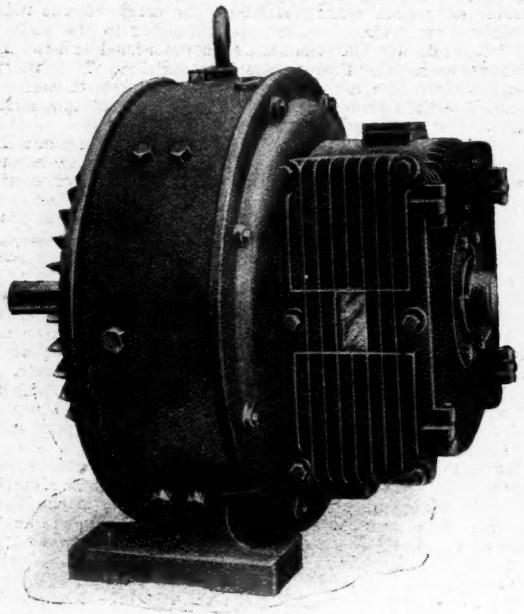


Fig. 2.—Phœnix Mining Motor.

Two large sealed inspection doors are provided, and observation windows are fitted, for the inspection of the brushes in the case of the D.C. type of motor. Big joint surfaces are provided; there are no oil chambers or passages, and the bearings which are placed outside the motor carcase have no direct communication with the interior of the machine. A series of explosion tests, carried out in the presence of mining experts, consisted in placing the motor in a specially built chamber, and after filling both chamber and motor with an explosive mixture of gas and air, exploding the mixture in the motor. This having no effect on the surrounding gas in the chamber, the latter was in turn fired (by means of a sparking plug) to show its explosive character. Internal explosions in the motor were also arranged, but no detrimental effect or external signs of the explosion were visible on the motor itself.

Quartzlite Heaters.

We have received from Messrs. Drake & Gorham, of 66, Victoria Street, S.W., some particulars of a neat little lantern-type heater, in which the Bastian patent quartzlite units are utilised.

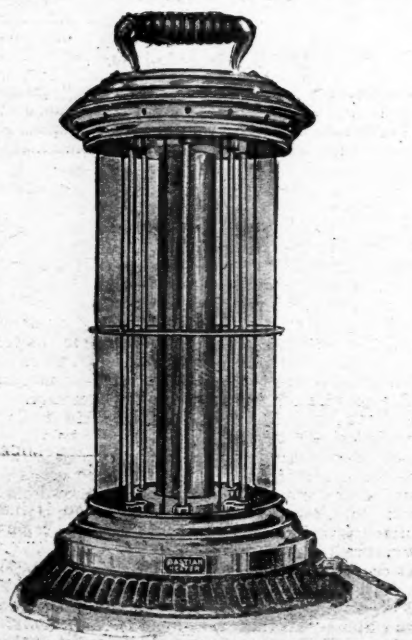
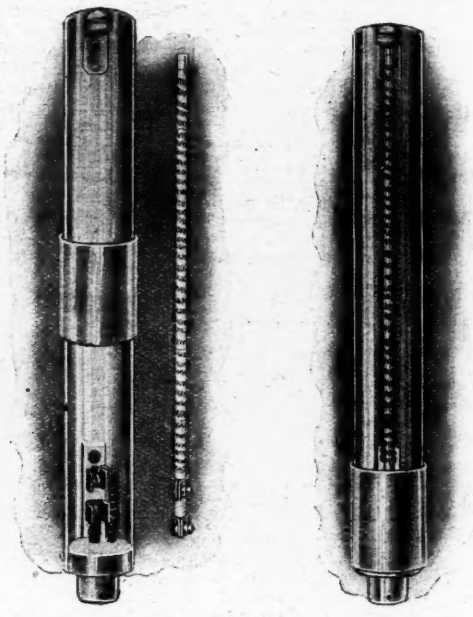


Fig. 3.—Lantern Heater.

This heater is shown in fig. 3; it is nickel-plated all over, except for the black handle and base. Messrs. Drake & Gorham are also supplying a new design of quartzlite heating unit, shown in figs. 4 and 5, for use in place of ordinary radiator lamps taking 250 watts each. The new element can be supplied for any convenient voltage, and to fit into the old lampholders; its increased heating effect is beyond question.



Figs. 4 and 5.—Exchange Type Heating Unit, showing Spiral Removed.

When using such glowers, it is necessary to fit a wire guard across the front of the heater, to prevent dresses, &c., coming in contact with the glowers.

Commutator Truing Machine.

In fig. 6 is represented an apparatus constructed by Mr. Oscar Kirchenberger, of Prague, which enables anyone to true up a commutator on the spot accurately and promptly without dismounting the machine. Its main advantages are substantial construction, small cost and ease of operation. The commutators or slip-rings are turned in the bearings of the machine, so as to be perfectly true.

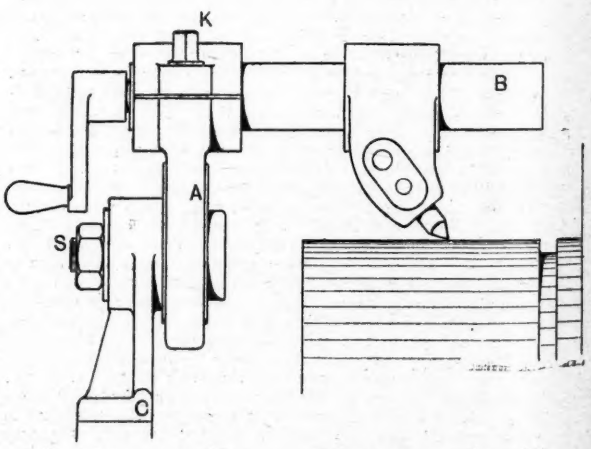


Fig. 6.—Commutator Truing Device.

After removing a brush-holder carrier with its insulation, the arm A is fixed in its place by means of a screw S as firmly as possible. The support B which is free to slide in the top part of arm A is then adjusted to reach over the width of commutator that requires turning down, after which the steel cutter is set in position, while the screw S and the bolt K are tightened up, and the brush-holder ring C is secured by tightening its set screw (generally fitted with a handle) so that it will not turn round. In the meantime the position of the cutter is slightly altered, coming into place of its own accord, so that even unskilled persons can do the work.

The cutting speed varies between 8 and 10 metres per minute. Where there is no motor for driving the armature, a crank should be attached to the end of the shaft, the armature being turned

round by hand. The steel cutter, which is made of first-class high-speed steel, must obviously be kept very sharp in order to secure satisfactory results.

The "Metallife" Anti-Vibrator.

The General Accessories Co., Ltd., of 148-150, Curtain Road, E.C., have recently introduced a lampholder designed to prevent the transmission of vibrations to metal-filament lamps. This is accomplished by carrying the weight of the lampholder and shade on a concealed spring, and providing the anti-vibrator with a cord grip, so that the flexible connected to the holder can be left slack, and thus will not interfere with the action of the spring. The device is also made with male or female thread for attachment to fittings.

Secret-Service Telephone.

Mr. J. A. Romer, of 1A, Lausanne Road, S.E., has devised an intercommunication telephone system for which he claims absolute secrecy, combined with the utmost simplicity in operation; it is said to be suitable for from 5 to 500 lines.

BUSINESS NOTES.

Electric Clocks.—The Silent Electric Clock Co., of 192, Goswell Road, E.C., have just completed a fine installation for the new Parliament House, Regina, Canada. This installation, with 50 dials controlled by a very handsome seconds-beat master clock, and a 24-hour programme ringer, is of special design, and the perfect quietness of the complete installation, even when all the dials are together in one room, is especially noteworthy. In connection with the recently aroused public interest in the synchronisation of clocks, we may add that the Silent Electric Clock Co., who have specialised in this matter, have just received the order to supply a large bracket clock and a number of inside dials for the new post office at Taunton. This installation will be electrically synchronised every day by the post-office time signal, the method being similar to that in use at the Aberdeen Town Hall, where a seconds regulator clock (receiving and sending out synchronising signals automatically) was recently supplied to the Town Council by the Silent Electric Clock Co.

Private Meetings.—Langdon-Davies Motor Co., Ltd., electric motor manufacturers, Deverell Street, London, S.E.—Pursuant to the provisions of the Companies (Consolidation) Act, 1908, a meeting of the creditors of the above was held a few days ago, at the offices of Messrs. C. F. Cape & Co., 12, Coleman Street, E.C. An extraordinary general meeting of the shareholders of the company was held on February 17th last, at Southwark Works, Deverell Street, S.E., when a resolution was passed to the effect that the company could not continue its business by reason of its liabilities, and that it was advisable to wind up the concern voluntarily. At the same meeting Mr. C. F. Cape was appointed to act as the voluntary liquidator of the company. Mr. Cape now reported that after the meeting of the shareholders the debenture-holders appointed a Receiver. There were debentures in existence for £6,000, while the assets consisted of machinery and unfinished stock valued at £6,500, and book debts estimated to realise £500. The liabilities of the company were £7,000. It was further stated that the company had not paid any dividends during the last three or four years. The company had had to face very keen competition, and had been hampered by its inability to buy material for cash. The ordinary shareholders of the company had subscribed £3,500, and that amount, together with the money found by the issue of debentures, had been lost. After discussing the position, the creditors appointed a Committee of three of their number to consult with the liquidator as to the possibility of arranging for the sale of the business as a going concern, with the consent of the debenture-holders, for a sum exceeding the claims of the debenture-holders.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—A 12-page catalogue, with a cover bearing the advice, "Shield your Workpeople—by using G.E.C. 'Home Office' Shock-proof Accessories." As this wording suggests, the firm have in this catalogue brought before the trade and engineers who are interested in the design and control of works and installations coming under Home Office purview, a variety of accessories conforming to the Government requirements. The following are included, illustrations and prices &c., being given:—Cut-out boards in teak cases, ironclad fuseboards, all-china switches, two-pin wall plugs, ironclad wall plugs, "Coates" insulating shields for ordinary and key socket lampholders, S.P. cut-outs, standards and bench lamps, portable hand-lamps, Salford switches for circuits up to 600 volts, single-pole house service cut-outs, and some other manufactures. In the design of all the foregoing the firm have complied with Form 928, February, 1910, which, as one method of protection, requires "all parts that are liable to be touched" to be provided "with shields, handles, or covers of insulating material." Where constructional or other difficulties have prevented the adoption of the insulating method, the alternative of efficient earthing has been provided for. The requirement that terminals of fuseboards and bus-bars should be recessed or ranged so that they cannot be inadvertently touched by the operator has been met in the S 942 shielded fuse-holder. Other requirements are specially met in the wall plugs and detachable ceiling roses shown in the list.

The Sun Electrical Co., Ltd., of 118-120, Charing Cross Road, London, W.C.—Advance sheet relating to their Coronation illumination devices and strip lighting, also to their "Suncolite" strip, which conforms to L.C.C. suggestions, is watertight and weather-proof, and is supplied in any length ready for fixing. Prices are given for standard lengths, of which large stocks are held. Other lists describe and price the "Sun" ironclad switch and the "Kalkos" switches.

The Electric and Ordnance Accessories Co., Ltd., Aston, Birmingham.—Illustrated catalogue (F 76) of "Ordnance" propeller fans for belt-driving or direct-coupling to A.C. or D.C. motors. Tables of speeds, code-words, prices and dimensions, are given.

Messrs. Mather Bros., 36, Farringdon Street, London, E.C.—Circular giving particulars and a number of illustrations of various designs of electric illuminating devices on the "Cremorne" system of wiring, suitable for the Coronation.

The Luna Metal-Filament Lamp Agency, 6, Bank Buildings, Town Hall, East Ham.—Leaflet giving some particulars and prices of "Luna" metallic-filament lamps of from 8 to 400 C.P., and for voltages from 25 to 260.

The Walsall Electrical Co., Ltd., 57, Bridge Street, Walsall.—Illustrated price sheet of automatic circuit-breakers, B. of T. leakage indicators, master switches and standard knife switches suitable for iron and steel works, collieries, and central station work. Copies will be sent on application.

The Eclipse Electric Co., Bootle.—Circular relating to the Whipple electric tire pump for garage and other service.

The Taikoo Dockyard, Hong Kong.—We have received from Messrs. John Swire & Sons, of 8, Billiter Square, E.C., an illustrated pamphlet dealing with the above dockyard and engineering works, which cover an area of 52 acres on the Island of Hong Kong. For the convenience of shipping, a large dry dock, three slipways, and a building yard are provided, with the necessary constructional and repairing shops. A 3,000-H.P. gas engine electric plant supplies power for the whole yard, which is within half-an-hour by electric car of Hong Kong city.

Messrs. Tetley & Co., Falcon Electrical Works, Salford.—Priced leaflets relating to the "Falcon" shock-proof switch-holders and safety hand lamps, also to rubber wires and cables, flexible cord, and bell wire.

Bankruptcy Proceedings.—G. V. B. Barker, electrical engineer, Leeds and Harrogate.—Mr. Registrar Perkins held a sitting at the Courts of Justice, York, last week, for the public examination of the above; but when the case was called, there was no response. The Official Receiver stated that he would consider whether he would apply to the Judge for a warrant for the debtor's arrest. The case was adjourned *sine die*.

Henry James Dale.—A sitting of the London Bankruptcy Court was held on Wednesday last week before Mr. Registrar Giffard, for the public examination of Henry James Dale, electrician, who failed on January with total liabilities £1,741 (unsecured, £642) and assets £36, after deducting £149 for payment of the preferential claims. Under examination by Mr. E. Leadam Hough, Senior Official Receiver, the debtor stated that for five years prior to October, 1907, he carried on business at 106, Pentonville Road, N. He then, with a capital of between £400 and £500, removed to 15, New Oxford Street, and in partnership with one Walter Kent he traded there under the style of the Scientific Appliance Manufacturing Co. Kent had been with him from boyhood. In June, 1909, witness started the Electro-Dynamic Medical Appliance Co. to exploit a medical appliance which he had invented, and in that venture he was joined in partnership by a Mr. Clark, who paid in a capital of £200. Mr. Kent retired early in December last, and Mr. Clark obtained the appointment of a Receiver of the business, the deed of partnership between them providing that in the event of the business becoming insolvent he was entitled to the return of his £200 and to an indemnity against the liability of the partnership. Witness did not know exactly how he now stood with Mr. Clark, but acting upon advice he had treated him in the statement of affairs as a creditor, and not as a partner. He attributed his insolvency to insufficient capital, heavy trade expenses, and to other causes. The examination was concluded.

Edward Surtees, electrician, 22, King Street, South Shields.—At the Newcastle Bankruptcy Court, on 2nd inst., this examination was resumed. Debtor was examined at some length by Mr. Gourlay (the Official Receiver) as to a debt of £34 10s. owing to him as the balance for certain work done, which had been applied, on January 25th, 1911, in payment on account of one of his creditors. Debtor said he did not make any protest against the debt being so applied because he was practically in the hands of the creditor for whom the work had been done, and he could do nothing but obey him. The examination was adjourned for a fortnight.

V. G. Burkitt (trading as V. G. Burkitt & Co.), electrical engineer, Bristol.—Mr. Registrar E. A. Harley held a sitting at the Guildhall, Bristol, last week, for the public examination of the above debtor on accounts showing a deficiency of £110. In reply to questions, the debtor said he bought his business from his previous employers, but subsequently he got into difficulties. The debtor stated that being required to keep up a certain position by his employers, and having his mother to maintain, he had been unable to put aside any of his salary for his creditors. Debtor was allowed to pass, the case being declared closed.

Joseph Perkins, formerly trading as an electrical engineer, Ebrington Street, Plymouth.—Before Mr. Registrar McCrea, at Stonehouse, on March 1st, Mr. A. N. F. Goodman, Official Receiver

mentioned this bankruptcy. He applied for an adjournment, pointing out that, for a variety of considerations, the matter would have to be gone into very carefully. Extreme difficulty had been experienced in getting a statement of affairs. The examination was adjourned until March 21st.

Ludwig Lehmann, hardware merchant and dealer in electrical goods, 68, Basinghall Street, and 26, Milton Street, E.C.—This case came before Mr. Registrar Brougham last week, in relation to the public examination. The debtor was brought to the London Bankruptcy Court in January on the petition of a creditor, and the estate has been placed in the hands of Mr. E. H. Hawkins, I.A., Charterhouse Square, E.C., as trustee, to be administered in bankruptcy. A statement of affairs has been lodged showing total liabilities £16,108, of which £12,189 is expected to rank against assets valued at £7,721. The debtor attributes his failure and insolvency to his personal expenses (estimated at £2,500 since January 10th, 1909) having exceeded the profits from his business. Mr. Albert Osborn (Osborn & Osborn) attended on behalf of the debtor, and obtained an adjournment of the examination for a fortnight to enable the cash and goods accounts to be lodged by his client. Mr. G. W. Chapman attended as Official Receiver, and Mr. Tindal Davis appeared for the trustee.

Installation Contracts.—Mr. H. Moss, of Bradford, has recently secured orders for a complete lighting and bell installation at Spring Grove House, Clayton West, for Mr. W. Beanland; a battery and switchboards, for R. Beanland & Co., Ltd., Clayton West; electric pump and extensions at the Old Hall, Emley, for Mr. R. J. H. Beanland; also the entire lighting, Coronation electrical illuminations, and heating, at the Al Fresco Pavilion, Frizinghall.

For Sale.—The Halifax Corporation has for sale a 300-kw., three-phase, 25-cycle alternator, coupled to a horizontal, slow speed, cross compound engine. The Wolverhampton Corporation has for sale by tender two 220-kw. Belliss-Parker 440-550-volt generating sets, with switchboard panels, one 200-b.h.p. Belliss and Morcom compound engine, and one 500-kw. Peache-E.C.C. 440-550-volt generating set. The Edinburgh Corporation has for disposal two 100-h.p. 250-volt Willans-Siemens d.c. generating sets and three 350-h.p. 500-volt Willans-Siemens d.c. sets. See our advertisement pages.

Osram Ashtrays.—The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., have just prepared for distribution among their friends a number of handy ashtrays somewhat after the similitude of an "Osram" lamp, of which it is intended to be a continual desk reminder. We have no doubt that the company will have a big demand for these useful articles. A line from any of the company's friends will bring one by return.

Book Notices.—The *Faraday House Journal* for February contains articles by old Faradians on pyrometry, horn-type dischargers, faults in d.c. machines, and three-phase transformation, and a letter from Mr. R. A. Chattock urging the necessity of training men for the commercial side of electricity supply undertakings. It is interesting to note that every Faradian who left at the end of the last two terms has already found a post.

"Electric Wiring, Fittings, Switches and Lamps." By W. Perren Maycock. 1911. London: Whittaker & Co. Price 6s. net.

"Practical Electricity." By W. E. Ayrton and T. Mather. 1911. London: Cassell & Co., Ltd. Price 9s. net.

"*Proceedings* of the American Society of Civil Engineers." Vol. XXXVII, No. 2. February, 1911. New York: The Society.

"A Guide to Commercial Finance." By A. G. Deacon & Co., chartered accountants, Manchester and Leicester. 2s. 6d. net.

"Science Abstracts," No. 158, February 25th, 1911. Sections A and B. London: E. & F. N. Spon. Price 1s. 6d. net each.

"The Physical Review," Vol. XXXII, No. 2, February, 1911. Lancaster, Pa: The *Review* offices.

"Report on the Pittsburgh Transportation Problem." By Bion J. Arnold. Chicago: From the Author, 181, La Salle Street.

Rosyth Naval Base Contractors.—The staff of Messrs. Easton Gibb & Son, the contractors at the Rosyth Naval Base, held their second annual dinner at Dunfermline. Mr. Gibb, head of the firm, presided.

Annual Dinner.—The employés of Electrical Installations, Ltd. (over 40 in number), held their fourth annual dinner and concert at "The Crown and Cushion" Hotel, London Wall, on Saturday last, 4th inst. Amongst those present were Mr. Horace Simon and Mr. Stanley Russ, the latter occupying the chair.

Tramcar Meters.—Messrs. Ferranti, Ltd., have just received instructions for the complete equipment of the tramway stock of the Corporations of Llandudno and Plymouth with their traction meters.

Dissolutions and Liquidations.—Midland Engineering Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. H. W. Brettell, 11, Waterloo Street, Birmingham, by March 31st.

Price, Friend & Co., electrical contractors, 6 and 7, St. John's Square, Cardiff, and Bridgend.—Messrs F. Price & H. G. P. Friend have dissolved partnership.

James Pitkin & Co., 56, Red Lion Street, Clerkenwell, E.C.—Messrs. James Pitkin and Herbert Brandon White have dissolved partnership. The electrical department of the firm has been taken over by Mr. White, and will be carried on by him under the title of the White Electrical Instrument Co., at 2 and 4, Gloucester Street, Clerkenwell, E.C.

Smoking Concert.—On Friday evening last at Stone's Restaurant, Pilgrim Street, E.C., Messrs. Siemens's Supplies Department held a smoking concert. Mr. A. H. Bate was in the chair.

Trade Announcements.—The Midget Electric Lamp Manufacturing Co., Ltd., have commenced business at Bothwell Street, Fulham Palace Road, Hammersmith, W., where they are engaged in the manufacture of "Midget" electric lamps for various purposes.

The Electrix Electrical Co., of Royal Arcade, Keighley, have just put on the market 24 new designs of Staghorn electric light and gas fittings, of which they are issuing photographs.

Messrs. Tasker, Sons & Co.'s successors have taken larger premises at 37, The Wicker, Sheffield, as being more suitable for their wholesale trade in mechanical leather and rubber goods.

The Blackburn and district business of "The late Howe Electrical Engineering Co., Ltd.," has been taken over by Messrs. J. W. Garsden & Co., electrical engineers, 24, Preston New Road, Blackburn, together with all contracts and work in progress.

LIGHTING and POWER NOTES.

Accrington.—The town clerk has reported to the Electricity Committee that the L.G.B. has declined to sanction borrowing powers for the extra-h.t. mains and plant within the borough of Haslingden in connection with the proposed supply of electricity to Haslingden, from Accrington. The Board desired the mains and plant to be purchased by Haslingden Corporation, who should apply for borrowing powers. This would necessitate a modification of the terms of the supply. It was decided to make the necessary modifications.

Ashford (Kent).—The U.D.C. on March 2nd decided to consent to the application of the East Kent Electricity Co. for a prov. order for E.L., subject to the compulsory area being extended to the town boundary in two directions.

Australia.—There is now a prospect that the long-discussed question of lighting Hawthorn (Vic.) by electricity will at last be carried out. For a full year the negotiations between the Council and the Melbourne Electric Supply Co. were carried on, the Council agreeing to hand over its rights to the company for 15 years, and the company agreeing to carry out a scheme of lighting embracing the principal business and residential streets of the city. Details, however, remained to be settled, and these have been constantly discussed in the interval by a committee of the Council and representatives of the company, and a draft scheme was to be submitted for the Council's approval. Should this be accepted, it would only remain to take a referendum of the ratepayers to authorise the assignment of the Council's rights to the company. The agreement gives the company the right to sell electricity to householders, and also to the municipal authorities for street lighting at certain rates, while the Council has the right to terminate the agreement at the end of 15 years and to purchase the company's plant at a valuation.—*Australian Mining Standard.*

Barnstaple.—The T.C. has entered into the following agreement with Messrs. Williams Bros., of Barnstaple, who, as stated in a recent issue of the Electrical Review, have been appointed official electrical contractors:—All incandescent lamps and fittings required by the Council shall be purchased from them at gross retail prices; all repairs to the E.L. installations on corporate properties shall be done by the firm at usual trade prices; the firm shall install the E.L. throughout their premises at 100, High Street, on completion of rebuilding, and consume current in each of the eight rooms at the usual prices; a number of lamps are to be kept burning on the ground and first floors and windows from the usual lighting-up time to closing time each business night of the year; four special window displays of one week each of electric appliances for lighting, and other uses are to be given between September 1st and May 1st in each year; no illuminant other than the Council's E.L. is to be used on the premises; a reasonable supply of lamps and fittings is to be kept in stock and displayed, these to include electric signs, radiators and motors; a competent wirer with expert knowledge is to be regularly employed. The agreement is to remain in force for three years, and after that period is to be determined by six months' notice on either side.

Barrow.—The T.C. on Monday decided that electricity required for decorative purposes on the occasion of the local celebration of the Coronation, be supplied to consumers free of charge, the customers to provide their own fittings, to erect the same to the satisfaction of the electrical engineer, and to pay a minimum charge of 2s. 6d. for the connection.

Belfast.—The city electrical engineer, Mr. Bloxam, has issued a return showing the output of current and the revenue received in connection with the municipal electric undertaking during the year ended December 31st last. From this it appears that 2,395,344 units were used for lighting, as compared with 2,140,234 units in 1909, being an increase of 255,110 units, or 11·9 per cent. For power, exclusive of the tramway supply, there were supplied 5,138,229 units, as against 4,245,223 units in 1909, being an increase of 893,006 units, or 21 per cent. For the tramways

there were used 7,722,305 units, as against 7,436,000, being an increase of 3·7 per cent. The revenue during 1910 was £46,791, against £40,383 in 1909, an increase of £6,408, or 15·8 per cent. The average price per unit to the public was, for lighting, 3·16d.; for power, 1·3d.; and the general average, 2·15d.

Argentina.—Mr. J. Bacigalupo has petitioned the Municipality of Mercedes (Province of Buenos Ayres) for a contract for the public lighting under almost similar conditions to the present company which holds the contract. He asks for a concession for 25 years, and proposes for the public lighting 200 arc lamps at $30 a month, and to charge 40 cents a KW. for private lighting.—*Review of the River Plate.*

Birkenhead.—The L.G.B. has sanctioned a loan for the purchase of a steam turbine, &c., for the Bentinck Street Electricity Works.

Burnley.—The agenda for the T.C. on March 2nd contained a motion applying to the L.G.B. for sanction to borrow £8,129 for the purpose of installing at the electricity station a 1,200-KW. turbine plant with tandem generators, and a motor-booster for lighting purposes. It was decided, however, to apply for a loan of £9,023 instead of £8,129. The Mayor explained it had been deemed preferable to install a 1,500-KW. set in place of a 1,200-KW. set, in view of the rapid increase in the demand.

The Corporation estimates are being prepared. The electricity department for this year estimated handing over from profits to the relief of the rates £4,000, but the year's operations had been so satisfactory as to enable that amount to be increased to £4,500. Moreover, the department hopes to hand over £4,500 on March 31st, 1912.

Canada.—According to the *Standard*, Winnipeg's municipal power plant is approaching completion. The works are situated on the Winnipeg River, some 70 miles distant, and will furnish ultimately 60,000 H.P. The present installation provides for 20,000 H.P. The turbines used are from Sweden and England, and the generators were made in Sheffield. All other electrical and auxiliary apparatus is of Canadian manufacture.

The Dominion Power and Traction Co. proposes adding to its plant in 1911, at the power house, a 6,400-KW. A.C., 2,400-volt generator and 7,100-H.P. turbine; at its Hamilton sub-station, an 8,000-KW. capacity Westinghouse equipment; and at its Brantford sub-station a 3,000-KW. capacity Westinghouse equipment.

Continental Notes.—Italy undoubtedly occupies a leading place to-day among the countries of Europe as regards its electrical industry, and in the spring of 1910 her output of electric power reached the total of 850,000 H.P., of which 580,000 H.P. was water generated. The works under construction, which will enter into operation in 1911, represent another 210,000 H.P. In the greater number of industrial establishments, electricity has displaced steam power. To confirm this, it is enough to examine the figures of coal imports. These in a decennium have barely doubled themselves—4,947,000 tons in 1900, against 9,264,000 in 1910—whereas the electrical plant will have risen in the same period from 82,000 H.P. to 1,500,000 H.P., of which 790,000 H.P. will be supplied by water. The capital invested in this industry now amounts to £30,000,000.—*Giornale dei Lavori Pubblici e delle Strade Ferrate.*

SPAIN.—The Hidro Electrica Vasco-Navarra is the title of a company just formed, to acquire three waterfalls in the Valley of Baztan, in the jurisdiction of Errazu, and on the River Bedassoa, respectively, for the generation and supply of electricity to the City of San Sebastian. A project is also on foot to erect a generating station at the mines of Son Fe, near Alcudia, on the Island of Majorca, the plans for which have been drafted by the engineer, Bartolomé Comas.

GERMANY.—A project, to cost 22 million marks, for the erection of a huge generating station for the supply of the towns, townships and rural centres in the districts around Coblenz, is now so far matured that the plans of two large contracting firms are under the preliminary investigation of a municipal official. His decision, which is expected almost daily, will have to be confirmed by a public meeting of the towns and districts interested, when the realisation of the project will be taken in hand.—*Elektrotechnik und Maschinenbau.*

Croydon.—Sixteen gas lamps in Whitehorse Road are to be replaced by 19 electric lamps, viz., 15 single, three treble and one double lamp fittings. Tramway posts are to be utilised as far as possible for the fixing of these lamps.

Darwen.—The Electricity Committee has decided to apply to the L.G.B. for sanction to borrow £7,600 for extension of mains.

At its meeting on March 6th, the T.C. decided to make a change in the charges for motor power. From April 1st consumers undertaking to use 10,000 units per quarter for the day load will be supplied at the flat rate of ½d. per unit.

Dublin.—The Joint Committee of the Richmond Lunatic Asylum has applied to the L.G.B. for its consent to the borrowing of £4,500 to equip the asylum for electric lighting. At a specially convened meeting of the Dublin Corporation on February 28th, it was decided by a large majority that application be made to the L.G.B. for sanction to a loan for further extensions to the electricity undertaking of the Corporation. The amount proposed to be borrowed is £128,000, which will be divided roughly as follows:—£40,000 for the erection of new machinery, £54,000 for extensions of mains and £24,000 for further machinery and plant.

Eastbourne.—The Grand Parade, from Cavendish Place to Carlisle Road, and Victoria Place, are to be electrically lighted by the T.C. on the occasion of the Coronation. It is to be suggested to the tradesmen in Terminus Road that they should consider the question of electrically lighting that road. The Secretary of the Ironmongers' Association has informed the T.C. that his association is in accord with the suggestion to include the hiring of electric cooking apparatus with that of electric motors. The electrical engineer is to inspect electric cookers and procure samples. The Electricity Committee has decided that where a large supply is taken for heating or cooking, and a comparatively small supply for power, the charge for the latter purpose be at the same rate as for heating.

Glasgow.—Work is proceeding at the Rothesay Dock with the erection of two 32-ton electric hoists for coal loading. There are also in course of construction two 4½-ton transporters, three 4-ton cranes, and 12 capstans, all electrically operated. The Rothesay Dock installation was referred to recently in our columns; it comprises at present two 32-ton coal hoists, 18 4-ton cranes, 27 1-ton capstans, two 18-ft. tipping turntables, and two 5-ton head capstans.

Grassington.—Mr. Harry Moss has resigned his position as engineer to the Grassington Electric Supply Co., Ltd. During the last six months the demand on this village station has risen from 30 per cent. to 85 per cent. of the total capacity of the plant.

Heston and Isleworth.—Up to January 31st the total number of connections was represented by 1,262 KW., as compared with 1,143 KW. at the corresponding period of the previous year. The number of consumers had increased from 647 to 764, and the number of public incandescent lamps using electricity was 408 as compared with 340. The horse-power of motors had gone up from 340 to 388½.

India.—A series of trials with various makes of arc lamps has recently been carried out in Calcutta on poles erected by the Calcutta Electrical Supply Corporation, with a view to a municipal arc lighting scheme. Amongst the lamps tried were the Crompton-Blondel, Multax, Arcturus, Butt, Excello, Flambo, Luminous, &c. Estimates were based on the use of 140 lamps, each burning 3,802 hours per annum. According to the *Calcutta Englishman*, the Excello lamp was found to be the cheapest in running cost, besides giving the greatest amount of light. It was also the most expensive lamp in first cost. The cost of 140 Excello lamps and poles would be from Rs. 57,400 to Rs. 61,040, according to type, and this number would be required to light the proposed route from Kalighat to Bag Bazar.

Ipswich.—A L.G.B. inquiry was held on February 28th into the application of the T.C. for a loan of £17,000, of which £6,007 was for money expended on buildings, machinery, meters, rental, wiring, &c.; £5,893 for future mains extensions, and £2,047 for rental, wiring and motors, arc lamps, &c. There was no opposition.

Subject to a satisfactory number of consumers being obtained, the T.C. will extend the mains to the California and Rosehill districts. Already numerous applications for current have been received.

Lancaster.—The T.C. has decided to have the E.L. installed in the new schools to be erected in Dallas Road at a cost of £13,783. A scheme is to be prepared for tendering, by an expert.

Leatherhead.—The U.D.C. has decided to offer no objection to the adoption of the Stannos system of service cables for houses, by the Electricity Co.

London.—SHOREDITCH.—In consequence of the negotiations as to a bulk supply to Bethnal Green, having fallen through, the Electricity Committee of Shoreditch Borough Council has forwarded to the Board of Trade a number of applications for supplies to premises in the Bethnal Green area, with a request for the Board's permission to such supplies being given by Shoreditch.

WOOLWICH.—The Council, at its last meeting, considered a letter from the secretaries of the joint conference of the London electric supply authorities *re* advertising, and the borough electrical engineer was authorised to expend the sum of £32 12s. 6d. for the purchase of leaflets, pamphlets, &c., during the ensuing 12 months and a similar sum for the purchase of posters during the ensuing 12 months. A report from the electrical engineer was received as to the means for securing uniformity in the manner of carrying out installation work on behalf of the Council. It was resolved that, in future, local wiring contractors executing installation work for the Council in connection with the hire-purchase and rental systems should be required to enter into contracts with the Council embodying conditions approved by the Committee.

THE METROPOLITAN AREA.—The Secretaries of the Joint Conference of London Electric Supply Authorities have issued a circular letter with regard to joint publicity. They state that the Conference has unanimously confirmed the following recommendations of the Executive Committee: (1) That with a view to further developing the commercial side of the Electric Supply Undertakings of London, the Conference co-operate with the Electric Supply Publicity Committee, particularly with a view to raising a special fund of about £1,500 for advertising, including an extensive display of large-size posters on the principal hoardings throughout London; and (2) that the Joint Secretaries invite those B.C.'s and company undertakings not at present represented on the Joint Conference of London Electric Supply Authorities or on the Electric

Supply Publicity Committee to contribute to such fund. The expenditure under the scheme is to be apportioned among the members of the Conference on the following basis:—(*a*) gross revenue of undertaking from private supply only not exceeding £10,000; (*b*) minimum annual contribution to the organisation £10; (*a*) exceeding £10,000 and not exceeding £20,000; (*b*) £20; (*a*) exceeding £20,000 and not exceeding £30,000; (*b*) £30; (*a*) exceeding £30,000 and not exceeding £40,000; (*b*) £40; (*a*) exceeding £40.000 and not exceeding £75,000; (*b*) £50; (*a*) exceeding £75,000; (*b*) £60. The scheme is to be carried out through the organisation of the Electric Supply Publicity Committee, which consists of the chief officials of B.C.'s and companies owning electric supply undertakings.

Marylebone.—The Finance Committee, in presenting the estimates for the year to end March 31st, 1912, make the following remarks: "During the current year, the conversion of the street lamps to electric incandescent lighting has been completed by the Electricity Department under arrangements approved by the Council. The estimate for the ensuing year shows a slight increase, which, we understand, is primarily on account of provision having been made for some further lamps on refuges which will probably be required during the year. The expenditure on public lighting in 1908-9, prior to the substitution of electric incandescent lighting, at the terms then current with the gas company, was £17,220, but this amount would have been reduced by about £1,000 per annum on the price of gas being altered from 2s. 5d. to 2s. 2d. per 1,000 cb. ft. Allowing for additional lamps already placed, and those to be provided, the present estimate still shows a saving of about £1,000 as compared with scale charges for gas lightingiat 2s. 2d. per 1,000 cb. ft.

Bermondsey.—The borough electrical engineer, with the commercial assistant, recently attended a meeting of shopkeepers which was held to consider the question of outside lighting on the same lines as now exist in Lewisham High Road, Catford, and elsewhere. The South Metropolitan Gas Co. and the South Metropolitan Electric Light Co. supply and fix outside lamps, and maintain and light same, for a fixed price per annum per post. The shopkeepers will require from 20 to 25 lamps along the pavement in Southwark Park Road, and the borough engineer suggested that the electricity department should provide them at £5 10s. per annum per post. The cost of providing 20 arc lamp-posts, &c., is £265, while the annual income from 20 lamps at £5 10s. will be £110. The annual cost of carbons and maintenance is estimated at £25 10s.; the maximum number of units to be consumed is estimated at 7,020 per annum, which, taken at 2d. per unit, means £58 6s. 8d; therefore, there will be a balance of £26 3s. 4d. for interest on, and replacement of, capital. The Committee has resolved that the outside lamps be provided as suggested.

Battersea.—With regard to the legal proceedings which were taken in connection with the explosion in an electric feeder pillar at the junction of Latchmere Road and Battersea Park Road, on October 29th, 1909, the total cost incurred by the Council in settling the actions amounted, it was reported at the last meeting, to £1,265.

Mellor.—The idea of harnessing the River Goyt for generating electricity for lighting and power for the Mellor district has been taken up by the Hayfield and Mellor R.D.C. There is an old mill available for use as a generating station, and the idea is to convey the current by overhead wires. As there are no gas works at Mellor, the carrying out of the scheme would be welcomed. A committee has been formed to consider the utility of the proposal.

New Zealand.—The Dunedin City Council has adopted recommendations made by its Electric Power and Lighting Committee providing for the extension of the plant at Waipori Falls by the addition of two units of 1,000 kw. each, at a cost not exceeding £60,000. Included in this estimated price was £10,000 for reticulation. The chairman of the committee stated that at present there are 1,100 consumers and plenty of prospective customers, and there was a large part of the city unreticulated. Applications to be connected had to be refused every day.—*Australian Mining Standard.*

Nigeria.—According to *African Engineering*, Abeokuta is to be provided with a water supply and electric light at a cost of £30,000. The works are in the hands of the native Egba Government.

Oldham.—The electrical engineer has submitted various recommendations as to revised charges for energy, including a reduction of the lighting (flat) rate to 3d. per unit; slot meters are also to be allowed up to 1 kw. of lighting, at an inclusive rate of 3½d. per unit. For power he recommends that the present rate of £2 10s. per kw. per annum, plus ½d. per unit, be extended to demands below 5 h.p. The matter is being considered by the Committee.

Penistone.—The U.D.C. proposes to provide electric power for the pumping station, and an estimate of the cost is to be prepared.

Pontefract.—As the B. of T. has no power to authorise a transfer of the U.D.C.'s E.L. order to the Light Railways Co., a Bill is to be promoted to enable the Council to transfer all its powers, on condition that the company pays the costs. The proposed transfer is for 42 years, with the option of purchase by the Council at the end of 27 years.

Portuguese West Africa.—Rapid progress is being made with the works for supplying Benguella, Catumbella and Lobito Bay with electric light and power. A concrete dam has been thrown across the Catumbella River and three 225-k.v.a. turbine-driven alternators are to be installed. Current will be stepped up to 22,000 volts and transmitted to a sub-station in each town, where it will be transformed for distribution on a three-wire 500-volt system. Messrs. Johnson & Phillips are carrying out the work.

Reigate.—The T.C. has decided to erect a new switchboard for the existing alternators, at a cost of from £400 to £500.

Rochdale.—The Gas and Electricity Committee has approved of the provision of further plant at the electricity works, in order to meet the increasing demand for current, especially for tramway traction. The scheme provides for another installation of boilers, engines, &c.

Rugby.—The U.D.C. has adopted a recommendation to expend during the summer, £1,170 in laying a new 125-h.t. feeder from the power house to the chamber in the public pleasure ground, and a four-core pilot cable; £735 for a new 125-h.t. feeder cable to a new chamber at the corner of Manor Road and Park Road; and £638 for new distributors. As a loan of £1,316 for a new steam alternator is not needed, the L.G.B. is to be asked to consent to its use for new mains.

Sheffield.—Mains are to be extended at a total cost of £1,331. The extensions include the following:—To supply Messrs. Seebohm & Dieckstahl, Ltd. (£588); to supply the Government Steel Testing Works (£229). The Watch Committee has had under consideration the question of electrically lighting Attercliffe Road, and it has come to the conclusion that instead of dealing with the thoroughfare in short lengths, it is better to include the whole lighting of Attercliffe Road in one operation. It is understood that before long the centre tramway poles may be removed, and in these circumstances the question of lighting the road by electricity, has been deferred for the present.

Tonbridge.—The U.D.C. has reduced the price of current for private arc lamps outside business premises to 3½d. per unit, a reduction of 1d. per unit.

U.S.A.—The question of water rights at Niagara will come up again shortly, when the Alexander Bill is introduced to the House of Representatives. This Bill seeks to remove entirely the restrictions upon Canadian power entering the States, and provides for a permanent diversion of 20,000 cb. ft. per second of water on the U.S. side of the falls. At the present time Canadian imported power has almost reached the agreed limit. The House of Representatives has defeated the proposed power development at Long Sault Rapids, St. Lawrence River, where a possibility of obtaining some 500,000 h.p. exists. Canadian public sentiment is against the proposal, which might interfere with her interests in the Sault navigation.

Wednesbury.—The Finance Committee of the Corporation proposes to borrow £5,460 for electricity purposes. The Electricity Committee has entered into an agreement with Messrs. Edward Elwell, Ltd., for the supply of electricity for power and lighting at Wednesbury Forge for a period of three years. For this purpose, the mains are to be extended at an estimated cost of £300, and an overhead service main is also to be erected at an estimated cost of £180.

York.—The electrical engineer has submitted to the T.C. an alternative scale of charges for current for private lighting whereby there is to be a fixed rental of 10 per cent. of the rateable value of premises, plus 1d. per unit for current.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Lancashire and Yorkshire Railway Co. has agreed to take over the scheme for the running of a light railway between Accrington and Clayton-le-Moors, which has been on foot for several years, and for which practically all the necessary capital has been subscribed. The Railway Commissioners will sanction the proposal, and the company will guarantee a 3 per cent. dividend on the working of the scheme.

Australia.—A meeting of the Melbourne Tramways Trust was held recently, when the proposal to form a municipal trust to take over the whole of the tramways of the city and suburbs, on lines laid down at the recent conferences of municipal delegates, was discussed briefly. It was stated that out of 24 replies to the circular addressed to municipalities by the conference, 22 were in favour of a municipal trust, the only two opposed to it being Northcote and Essendon, which each had tramways of their own.

Bacup.—A special meeting of the T.C. was held on the 1st inst. to comply with the provisions of the Railway Clauses Consolidation Act, 1863, to authorise the common seal of the Corporation to be affixed to the agreement with the Rochdale Corporation as to the construction and working of the Bacup Light Railway. The light railway is to run from the centre of the town to the borough boundary at Britannia, where it will join the Rochdale tramway system.

Barrow.—By 25 votes to 4, the T.C. on Monday decided not to take over the tramway undertaking in the borough at the expiration of the first period of seven years, provided for in the agreement of August 2nd, 1902, with the British Electric Traction Co. In regard to the proposed extension of the tramways on Walney Island, a sub-committee was appointed to approach the B.E.T. on the matter. The borough treasurer estimated that the rates of the borough would be increased by 4¾d. in the £ if the tramways were purchased, and during discussion it was reported that the compensation to be paid to the B.E.T. in the event of the Corporation taking them over was £95,000.

Birmingham.—The chairman of the Corporation Tramways Committee admitted at a meeting of the City Council on Wednesday last week that a contract for tramway rails of the value of £11,000 had gone to a German firm. The statement was received with cries of "Shame," to which the chairman replied that there was a saving of £900 on the contract, as compared with the lowest English tender received. The Committee, he added, would see that the standard rate of wages was paid in the district where the rails were manufactured. Only two English tenders were received.—*Financier.*

Blackpool.—At the T.C. on Tuesday Alderman Brodie protested against what he described as the disfiguring of the cars and shelters by advertisements. The Tramways Committee had accepted a tender for advertising on the tramcars, and decided to invite tenders for the exclusive right of advertising in the tramcar shelters. He considered it a disgraceful thing to disfigure the cars and shelters. The proposal to advertise on the shelters was referred back, but an amendment to refer back the question of advertising on the cars was defeated, after Alderman Brodie had pointed out that the contract had already been let.

Canada.—The British Columbia and Dawson Railway Co. has been incorporated to construct a railway from Lyttleton to Fort George, and through Northern British Columbia to Dawson City.

Continental Notes.—Spain.—What is described by *Electron* as the "first enterprise of its kind in Europe," is the introduction of electric trains between the stations of Gergal and Santa Fe, in the Province of Almeria. The rolling stock consists of five electric locomotives made to draw trains of 250 tons at a speed of 30 km. per hour. The system is said to be an exact copy of that in the Simplon Tunnel. The power house is situated at Santa Fe, the plant consisting of two boilers and a 1,500-kw. steam alternator working at a pressure of 5,000 volts.

Italy.—Application has been made for the concession for the construction of a railway from Orbetello to Orvieto, a distance of 116 km., through a vast region as yet unserved by railways. The provinces of Rome, Perugia and Siena and, in a special measure, Grossieto, are particularly interested in the scheme, which, besides creating an increasing tourist and passenger traffic, will unlock the vast mineral resources of regions around Monte Amiara in sulphur, antimony, manganese, mercury, anthracite, basalt, marble, &c. Considerable engineering difficulties will have to be surmounted, no fewer than seven tunnels and numerous bridges and lofty viaducts being required in the rugged country which the line will traverse. No mention of the motive power to be used is made by our contemporary, the *Giornale dei Lavori Pubblici*, from which we quote, but it is probable it will be electricity, as the water resources of the region in question are by no means small and the magnificent Lake Bolsena lies not far from the line.

Dartford.—The U.D.C. has renewed for five years the lease of the light railways to J. G. White & Co., Ltd., and consented to the assignment of the lease to Balfour, Beatty & Co., Ltd.

Glasgow.—For the past 12 months the T.C. has been inundated with applications for the extension of the tramway system to suburban and other districts hitherto untapped. All these applications have now been deliberated upon by the responsible committee, and it has been decided to decline the invitations to ask power to extend the system from Bishopbriggs to Kirkintilloch; St. Rollox to Provanmill; Uddingston to Belleshill; Rouken Glen to Mearns; Burnside to Cathbin Braes; Baillieston to Dunlocher, to Carmyle, Balgrayhill, and Scotstounhill. A report will be issued on the advisability of the following extensions being proceeded with—Baillieston to Coatbridge; Cathcart to Busby; Corrusburn to Milngavie and Bearsden; and to University Avenue, Helen Street, Govan and Buchanan Street, *via* St. Enoch Street to the South side of the city. The entire length of all the proposed extensions was about 50 miles.

The T.C. has now put into operation the scheme for permitting totally blind people to travel free by car. A supply of brass tokens has been distributed among the various institutions concerned in the amelioration of the optically afflicted, and officials in these establishments are co-operating with the general manager in the proper working of the scheme. An ordinary car ticket is given each blind person in exchange for the brass token, and it is considered that the cost of thus conveying afflicted persons will be charged to the Common Good fund of the city, as a donation on behalf of the blind of the city.

Halifax.—The Tramways Committee has decided to drop the proposals for additional tramways to Mytholmroyd, which are contained in the Corporation Bill. This action has been taken in consequence of the requirement of the West Riding C.C. that the Corporation should agree to pay one-half the cost of paving margins less than 9 feet in width between the carriage-way and the edge of the tramway track, the same to be afterwards maintained by the road authority.

Hull.—According to the local papers, Alderman Robson, chairman of the Tramways Committee, has tendered his resignation, as a protest against the policy of the Committee in agreeing to the abstraction of tramway surpluses in relief of the rates. The Alderman objected on the very good ground that the tramway profits have dropped £19,000 in three years; he, therefore, opposed the giving of £12,000 in relief of the rates, more especially as considerable expense will shortly have to be incurred for maintenance of cars.

Liverpool.—The Tramways and Electricity Committees have decided to make application to the L.G.B. and the B. of T. respectively, for sanction to borrow sums of £25,000 for the provision of electric mains, and £10,000 for new tramway cars.

Nelson.—On March 2nd it was reported that terms had been arrived at with Colne and Trawden Light Railway Co. for the through running of cars from Nelson centre to Lower Shawbridge and Trawden.

South Africa.—According to the *African World* the proposals for building an electric railway from Pretoria to Johannesburg are making headway, and there is reason to believe that the Government will adopt them and proceed with its construction at an early date. The distance from Johannesburg to Pretoria is 34 miles.

West Bromwich.—The differences which have existed for some time between the Corporation and the tramway company, and which threatened litigation, have now been amicably settled. The tramway company have agreed to take a minimum of 900,000 units of electrical energy per annum, at prices ranging from 2d. to 1d. per unit, the scale being so arranged that it will yield a substantial increase in the amount which will come into the Corporation's exchequer. There has also been a revision of the allowance to be made by the company for the repair of the track, and under the new arrangement the company will pay £1,000 for the first year, £1,100 per annum for each of the next three years, and £1,200 per annum for each of the three succeeding years, compared with £900 a year under the old agreement. The General Purposes Committee of the Corporation has, in return for this, agreed to the use of the smaller cars and to a 7½ minutes' service on one section and a 15 minutes' service on the other section of the tramway company's system.

Worthing.—A public meeting convened by the Worthing and District Ratepayers' Association on Monday evening passed a resolution expressing the opinion that the proposed scheme for electric tramways between Brighton and Worthing would be of great benefit to the town, a boon and convenience to the people, and also attractive and specially advantageous to the visitors. The resolution further expressed hearty support of the Bill, and called upon the Worthing T.C. either to withdraw its opposition and support the scheme, or to state a reason for its opposition.

U.S.A.—The pile driving in connection with the Boston Elevated Railway Co.'s South Boston power station is now being carried out. According to *Electric Traction Weekly*, the initial power equipment in this station will be two 15,000-kw. turbo-generators, and the design provides for an additional 15,000-kw. unit and further units of 20,000 kw. capacity for the future. No larger units than these have been installed anywhere as yet, though four units of larger capacity are planned for the service of two central station companies. These machines will generate current at 6,600 volts, which will be stepped up to 13,200 volts for transmission to some five or six sub-stations, located in suburbs. The new station has a capacity equal to the combined capacities of the Lincoln, Charlestown and Harvard stations, the largest of the company's existing stations, while one of the new turbines will turn out as much power as the entire Lincoln station, the largest of the older plants. In addition to the power station there will be installed in South Boston extensive coal-handling apparatus and a coal store of 100,000 tons capacity.

According to figures published by the Public Service Commission, the four elevated lines of the Interborough Rapid Transit Co. are still carrying more passengers than the subway, but the lead is gradually diminishing. In 1910, tickets sold on the elevated lines showed an increase of 4·5 per cent. as compared with 1909; for the subway the increase was 5·24 per cent. Approximately 299 million tickets were sold on the elevated lines in 1910, as compared with 270 millions in the subway.

The Pay-as-You-Enter Car Co. has signed contracts for about 7,000 cars (out of a total of some 25,000 cars operated by the tramway companies). A dozen of these cars are on order for the Calgary Street Railway, Canada.

TELEGRAPH and TELEPHONE NOTES.

South Africa.—In a recent issue the *Cape Argus* states that a remarkable development has taken place in the last year or so in regard to telephonic communication in South Africa. The number of applications has increased by quite 60 per cent. in the last couple of years; not only does the business man in the town realise its value, but the intelligent farmer is also finding that tele-

phonic communication puts money in his pocket. Individual farmers are beginning to ask for telephonic connections of their own, and a perfect network of telephones is spreading over the country. Since the establishment of the Union, very appreciable reductions have been made in the rates on the trunk lines. The reduction which took place in November last has led to a very large increase in the number of calls, so that the department has had to put up extra wires in Paarl, Muizenberg and other places.

U.S.A.—According to the *Electrical World*, the National Independent Telephone Association, at its annual convention in Chicago last month, expressly denied the report that the merging of the Independent and Bell interests had been sought by the officials, and confirmed its complete independence of the Bell interests.

Wireless Telegraphy.—Seven of the ships belonging to the fleet engaged in the Newfoundland seal fishery are being fitted with the Marconi wireless telegraph apparatus.

The Brazilian Government has commissioned the German Telefunken Co. to erect six large stations in Brazil. Argentina, Peru, Chile and Uruguay have also decided to establish State monopolies in wireless telegraphy, and have ordered a number of stations from the Telefunken Co.

It is stated that the Indian Government intends to erect a wireless station near Point de Galle.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberaman.—March 13th. Electrical goods, for the directors of the Powell Duffryn Steam Coal Co., Ltd., 101, Leadenhall Street, London, E.C., Stores Manager, Aberaman Offices, near Aberdare.

Accrington.—Tramway storage battery, for the Corporation. See "Official Notices" March 3rd.

March 11th.—Tramway stores for the T.C., for a year; Tramway Offices.

The Electricity Sub-Committee is to obtain tenders for one 200-KW. extra-high-pressure alternator, and for effecting, at an estimated cost of £275, certain improvements in one of the 400-KW. motor-alternators recently purchased, to enable it to generate extra-high-pressure current at 6,600 volts.

Australia.—April 4th. 10¾ miles of lead-covered cable, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

May 8th.—Battery of accumulators, with boosters and switchboards, for the Melbourne City Council. See "Official Notices" February 24th.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

April 19th.—Five motor-generators and one switchboard, for the P.M.G.'s Department in South Australia. See "Official Notices" to-day.

April 25th.—175 miles of telephone cable, lead-covered, paper-insulated, and 717,000 paper sleeves, for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

MELBOURNE.—April 19th. Deputy Postmaster-General. Telegraph and telephone material. Specifications, &c., High Commissioner, 72, Victoria Street, S.W.

Austria.—March 22nd. The Austrian State Railway authorities, at Villach, are inviting tenders for the establishment of an electric lighting and power plant at the railway workshops at Knittelfeld.

Austria-Hungary.—May 15th. Supply and erection of switchboards for the new telephone exchanges in Vienna; Ministry of Commerce, Vienna.

Beckenham.—March 20th. Meters, for the U.D.C. See "Official Notices" February 24th.

Bolton.—March 30th. Materials and stores for a year, for the Corporation Electricity Department. See "Official Notices" to-day.

Bootle.—March 20th. Slack, for the Corporation electric light station, for 6 and 12 months. Borough Electrical Engineer.

Bray.—March 21st. Stores for the U.D.C. electricity works. See "Official Notices" to-day.

Burnley.—March 13th. The Guardians have decided to obtain tenders for electrical work for the ensuing year.

Canada.—March 22nd. Tenders are invited by the City Commissioners of Calgary for the supply of a 1,500-KW. turbo-generator set with condenser, &c.; one 100-KW. exciter; and three 1,000-K.V.A. single-phase transformers, 12,000 to 2,300 volts, with switching gear, &c. Tenders to the City Commissioners, Calgary. A deposit of 2 per cent. of the value of the offer must accompany each tender. Specifications, together with a drawing, may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Cardiff.—March 16th. Electric light sundries, for the Mental Hospital, Whitchurch, for a year (Form 24). Clerk and steward, the Asylum.

Dublin.—March 16th. Electric lighting of the Great Brunswick Street Public Library, for the Corporation. Specification, City Electrical Engineer, 10s. 6d., returnable.

Dudley.—Steam slack coal, for the Corporation generating station, for the T.C. C. E. Savage, borough electrical engineer, Bull Street power station.

Eccles.—March 20th. One 500-K.V.A. steam engine, single-phase generator and exciter, for the Corporation. See "Official Notices" February 24th.

Germany.—March 27th. The Prussian State Railway authorities, at Posen, are inviting tenders for the supply and erection of an electrically-operated locomotive turntable.

Gillingham.—March 20th. Materials and stores for a year, and purchase of scrap material, for the U.D.C. Electricity Department. See "Official Notices" to-day.

Glasgow.—One turbo-generator for the Pinkston power station. Mr. W. W. Lackie, chief engineer.

Kendal.—March 14th. Underground feeder, for the Corporation Electricity Department. See "Official Notices" March 3rd.

Kingston-upon-Hull.—March 28th. Two 2,000-KW. turbo-alternators, for the Hull Corporation. See "Official Notices" to-day.

Leyton.—The Surveyor has been instructed to prepare plans for the cooling-tower pond and the foundation and trench work for the turbine set. Tenders are to be invited for the work.

London.—MARYLEBONE.—March 15th. (Amended notice.) Supplies, for a year, for the B.C. Electricity Department. See "Official Notices" February 24th.

L.C.C.—March 15th. Electrical installation at the Trade School for Girls, Belvedere Place, S.E. See "Official Notices" Feb. 24th.

March 21st.—Electric bellhangers' work, for three years, for the Commissioners of H.M. Works and Public Buildings. See "Official Notices" March 3rd.

March 28th.—Four electric watering-cars, with rail-grinding apparatus, and four complete electrical equipments for the same, to operate on both overhead trolley and conduit systems. See "Official Notices" to-day.

HAMMERSMITH.—Tenders are to be invited for two 200-KW. and two 100-KW. transformers, also switchgear required in the various sub-stations during the next 12 months.

March 29th. High and low-tension switchgear and air-cooled static transformers, for the B.C. See "Official Notices" to-day.

HACKNEY.—April 6th. Two water-tube boilers, one motor turbine feed pump, and reconstruction of portion of the coal conveying plant, for the B.C. Electricity Department. See "Official Notices" to-day.

Margate.—March 22nd. Electric lighting of a concert pavilion at the Fort, for the Corporation. See "Official Notices" to-day.

Norwich.—March 13th. Station battery, and motor-driven booster with regulating apparatus and switchboard, for the Electricity Committee. See "Official Notices" March 3rd.

Pontypridd.—March 14th. Stores and materials for a year, for the U.D.C. Electric Lighting and Tramways Departments. See "Official Notices" March 3rd.

Reigate.—March 22nd. Two Diesel oil engines coupled to 100-KW. single-phase alternators, with exciters, &c., and main switchboard, for the T.C. See "Official Notices" March 3rd.

Rotherham.—March 23rd. One 1,000-KW. steam turbo-alternator, condensing plant, piping, H.T. switchboard gallery, switchgear, &c., for the Corporation Electricity Department. See "Official Notices" March 3rd.

Salford.—The Tramways Committee is inviting tenders for special track work for the renewal of Cross Lane junction. Send stamped addressed envelope to the General Manager, 32, Blackfriars Street, Salford.

South Africa.—April 3rd. Rand Water Board, Johannesburg. High-lift centrifugal pumps, generating and condenser sets, transformers, poles, insulators, copper wire, &c., and about 29,500 ft. of 16-in. and 29,500 ft. of 18-in. steel pipes and specials. Sealed tenders to Secretary, Rand Water Board, Corner House, Johannesburg. Early delivery. It is practically necessary for tenderers to have local representatives. Specification, together with drawings, may be seen at the Commercial Intelligence Branch of the Board of Trade, London.

Spain.—Tenders have lately been invited by the municipal authorities of Salamanca for the concession for the electric lighting of the town during a period of ten years.

Swindon.—March 15th. Stores, meters, oils, &c., for a year, for the Corporation Electricity and Tramways Department. See "Official Notices" March 3rd.

Tonbridge.—March 20th. Cables, meters, arc lamp carbons and sundry stores, for the electricity department of the U.D.C., for a year. H. W. Peach, clerk, Tonbridge Castle.

Wakefield.—March 27th. Three steam superheaters, for the Corporation Electricity Department. See "Official Notices" to-day.

Warrington.—March 14th. Electrical requisites, for six months, for the B.G.; A. Bottomley, clerk, Bewsey Chambers.

Whittingham (near Preston).—March 23rd. Electric sundries, for the Lancashire County Asylum. W. N. Baldwin, clerk and steward.

Wrexham.—March 17th. Supplies, for the T.C. Electricity Department. See "Official Notices" March 3rd.

York.—March 14th. 1,000-KW. turbo-generator and condensing plant, transformers and switchgear, water-tube boiler, feed pumps and pipework, for the Corporation. See "Official Notices" February 24th.

CLOSED.

Aberdeen.—The offer of the Aberdeen Electric Engineering Co., Ltd., has been accepted for lighting and power supply for the new John Knox Church.

Accrington.—The T.C. has accepted the tender of Messrs. R. T. Garland & Co., for £34, for the work of extending the fire-alarms.

The T.C. was informed last week that the contractor for the extensions of the electricity works had declined to sign the contract, and the work was therefore given to Messrs. Geo. Cunliffe & Sons, who were the next lowest contractors.

Ashford (Kent).—The U.D.C. has accepted the tender of Messrs. Gent & Hurley for the installation of the electric light at the sewage works, at £66 10s.

Australia.—According to the *Australian Mining Standard*, the tender of the Sydney Electrical Engineering Co., Ltd., at £1,798, for the installation of electric lighting at the Coast Hospital, Little Bay, New South Wales, has been accepted.

Bacup.—The T.C. has accepted the tender of Messrs. W. T. Glover & Co. for cables, ducts, &c.

Blackburn.—The T.C. has accepted the following annual contracts for the Electricity Department:—

L. Andrew, Manchester.—Micanite plate, ebonite, shellac, &c.
Spicer Bros.—Fibre sheet and presspahn.
Gutta-percha Works, Manchester.—India-rubber solution.
Siemens Bros.—Ozokerit tape, insulating paint, &c.
W. T. Henley.—Waterproof tape.
Turners & Manville.—Armature insulating varnish.
R. W. Blackwell & Co.—Insulating tape.
Vacuum Oil Co.—Oils.
Ferranti, Ltd.—Motor-starting switches.
Brotherton Co.—Screwed tubes.
Tucker & Co.—Tumbler switches, fuses, lampholders, &c.
General Electric Co.—Switches.
British Insulated and Helsby Cables.—House-service fuse boxes.
Wilkinson, Heywood & Clarke.—Acid-proof paint.

Bognor.—The U.D.C. on Friday accepted the tender of Messrs. Manlove, Alliott & Co., Ltd., of Nottingham, for a refuse destructor, at £2,403.

Burton-on-Trent.—The T.C. has accepted the offer of John Richards to supply and erect 130 metallic-filament lamps on existing electroliers and brackets in a portion of the Town Hall, at a cost of £16 5s.

Bury (Lancs.).—The Education Committee has accepted the tender of Mr. T. Cornall, of Bury, for the electric light installation at Elton Schools.

Hull.—From several tenders sent in for the new machinery, &c., in connection with the electrification of Soulcoates Bridge, the Corporation Bridges Committee has accepted that of Sir W. G. Armstrong, Whitworth & Co., at £2,180, which was the lowest tender but one.

Glasgow.—The Tramways Committee recommends the acceptance of the following tenders:—

Steel renewable plates for special work.—Acme Steel and Foundry Co.
Single core lead-covered cable.—W. T. Henley's Telegraph Works, Ltd.
Special track work.—Lorain Steel Co.
Three goods hoists for Corporation-owned building at corner of High Street and Bell Street.—Messrs. John Binnie, Ltd., at £210 each.
Two passenger hoists.—Messrs. A. & P. Steven, at £293 each.
Electric main switches and cables, &c.—Messrs. Underhill & Ritchie, Ltd., £92.

Leicester.—The T.C. has accepted the tender of the Leyland Motors, Ltd., of Preston, for the chassis of a motor tower wagon, at £565; and that of the North-Eastern Steel Co., Ltd., of Middlesbrough, for 50 tons of steel tramway rails, at £7 per ton and 5s. per ton royalty.

Leyton.—The U.D.C. has accepted the following tenders:

Felten & Guilleaume.—Annual supply of service line cable.
Wakefield & Co.—Engine oil for the electricity undertaking.
Oliver Arc Lamp, Ltd.—45,000 pairs of Oliver flame arc lamp carbons.

London.—HAMMERSMITH.—The Council's Electricity Committee recommends the following tenders for acceptance:—

Electrical goods.—General Electric Co., Ltd., £31.
Firebricks, clay, &c.—Mobberley & Bayley, £37.
Iron castings.—W. Lucy & Co., £429.
Insulated wires.—Standard Cable Co., £89.

There were 16 tenders, ranging from the latter sum to £156, at which highest figure five British firms tendered.

For arc lamp globes, carbon-filament lamps, no tender is to be accepted pending further inquiries.

The tenders for metal-filament lamps were as below, the tender of the General Electric Co. being accepted, as the deciding factors are the quotation for lamps of 100 C.P. and the life of the lamp:—

Lund Metal Filament	£480
E.M.F., Ltd.	418
British Westinghouse Co.	460
British Tungsten Electric Lamp Co.	484
Edison & Swan Electric Lamp Co.	522 net.
Brush Electrical Co.	564
Drake & Gorham	586
General Electric Co.	583
Simplex Conduits, Ltd.	616
British Electrical Manufacturing Co.	634
Johnson & Phillips	668

Oils.—C. Price & Co. (dynamo oil); Valvoline Co. (turbine oil); W. H. Wilcox (cylinder oil).
Steam packing and jointing materials.—Pryke & Palmer.
Meters.—British Thomson-Houston Co., Ltd.
" (prepayment).—Ferranti, Ltd.

SHOREDITCH.—The Electricity Committee received tenders as follows for cables, lead sheathed, paper insulated, and in accordance with the specification of the Engineering Standards Committee, revised edition March, 1910, suitable for a working pressure of 660 volts D.C.:—

Name.	1 inch. 2/3 miles	·6 inch. 1 mile.	·33 ¼ mile.	·2 2 miles.	·1 1 mile.	·05 2 miles.	Guarantee.
	Per mile. £	Per mile. £	Per mile £	Per mile. £	Per mile. £	Per mile. £	Year.
Siemens Bros. & Co., Ltd.	1,170	640	442	149	106	58	1
W. T. Glover & Co., Ltd.	1,185	649	476	153	108	59	—
W. T. Henley's Telegraph Works Co., Ltd.	1,185	660	465	156	110	59	1
British Insulated and Helsby Cables, Ltd.	1,190	656	444	152	110	60	1
Western Electric Co., Ltd.	1,193	652	451	152	108	59	1

The Committee recommends that the lowest tender, that of Messrs. Siemens Bros. & Co., Ltd., be accepted.

BATTERSEA.—The B.C. has accepted the following tenders for annual supplies:—

Cables, &c.—Callender's Cable and Construction Co., Ltd.
Nernst lamps and globes, &c.—Electrical Co., Ltd.
Carbon-filament lamps.—British Thomson-Houston Co., Ltd.

There has also been accepted the tender of Babcock & Wilcox, Ltd., at £139, for a superheater.

ISLINGTON.—The B.C. has accepted the following tenders for annual supplies to the Lighting Department:—

Arc lamp carbons.—Sloan Electrical Co., Ltd.
Arc lamp globes.—Wm. Geipel & Co.
Transformers and accessories.—British Electric Transformer Co., Ltd.; Ferranti, Ltd.
Electricity meters.—B.T.-H. Co., Ltd.; British Westinghouse Co., Ltd.
Cables.—B.I. & Helsby Cables, Ltd.; W. T. Henley's Tel. Works Co., Ltd.
Electrical sundries, lamps, brushes, arc lamp parts, &c.—British Tungsten Lamp Co.; S. Horvath; General Electric Co., Ltd.; Heap & Johnson; A. Round.
Cable terminal service and network boxes.—Callender's Cable and Cons. Co.; W. Lucy & Co., Ltd.; B.I. and Helsby Cables, Ltd.; Sykes and Sugden, Ltd.; Wicks & Dale; H. Young & Co., Ltd.; Dussek Bitumen Co.; L. Andrew & Co.; General Electric Co., Ltd.
Oil-break switches.—Johnson & Phillips, Ltd.

WOOLWICH.—The B.C. has accepted the tender of Messrs. J. & H. Grevener for 28 flame arc lamps, at £108 10s. It has further accepted the following tenders for carbons:—Sloan Electrical Co., 20,000 pairs, £80 0s. 6d.; Oliver Arc Lamp, Ltd., 77,000 pairs, £254 10s.; Ship Carbons, Ltd., 20,000 pairs, £166 6s. 9d.; J. & H. Grevener, 20,000 pairs, £210 10s.

Manchester.—The British Westinghouse Electric and Manufacturing Co., Ltd., have secured the order from the Partington Steel and Iron Co., Ltd., for four mixed-pressure "impulse type" turbo blowers for blast furnace work, and an electric generating set. The machinery in question is required for the extensive new works which the Partington Co. are erecting in the neighbourhood of Manchester.

Loughborough.—The Corporation Electricity Supply Department received the following tenders for two 350-KW. turbo-dynamos :—

Name.	Price for 2 machines.	Time for delivery.	Time for erection and testing on site.	Efficiency at full load.	Speed. R.P.M.
	£			%	
Siemens Bros. Dynamo Works, Ltd...	1,700	6 months	2 weeks	89·0	2,700
British Westinghouse Electric and Manufacturing Co., Ltd.	1,652	5 to 6 months	6 months	92·5	3,000
Phœnix Dynamo Mfg Co., Ltd. ..	1,600	5½ months	3-4 weeks each	93·5	3,000
Lancashire Dynamo & Motor Co., Ltd.	1,558	20 weeks	6 weeks	91·5	3,000
Electric Construction Co., Ltd.	1,497	22 weeks	3 weeks	93·0	2,700
Brush Electrical Engineering Co., Ltd.	1,368	16 weeks	1 week	93 0	2,800
Laurence, Scott & Co., Ltd.	1,300	6 months	2 weeks	91·5	2,600

Redcar.—The U.D.C. has accepted the tender of the National Telephone Co. for providing fire alarms, at £82.

Sheffield.—The City Council has accepted the following tenders for annual supplies :—

TRAMWAYS DEPARTMENT.

Armature spares.—Dyer & Young; Samuel Peace & Sons.
Gear cases.—British Thomson-Houston Co., Ltd.
Commutators and segments.—Dyer & Young.
Controller fittings.—L. Andrew & Co.; B.T.-H. Co., Ltd.; M. Bonser and Co.; Traction Supplies Co., Ltd.; Estler Bros.
Weldless steel tubes.—British Mannesmann Tube Co., Ltd.
Trolley heads, wheels, &c.—Brecknell, Munro & Rogers, Ltd.; Geo. W. Allsop, and Samuel Peace & Sons.
Traction lamps.—General Electric Co., Ltd.; Edison & Swan Co., Ltd.; Electrical Co., Ltd.
Carbon brushes and arc lamp carbons.—B.T.-H. Co.; Morgan Crucible Co., Ltd.; Le Carbone, Ltd.; India-Rubber, G.-P. and T. Works Co, Ltd.; Wm. Geipel & Co.
Car electric supplies.—M. Bonser & Co.; J. Thompson; B.T.-H. Co., Ltd.; Cocker Bros.
Electric light and bell fittings.—Edison & Swan Co., Ltd.; General Electric Co., Ltd.: J. H. Tucker & Co.
Cable, &c.—I.-R., G.-P. and T. Works Co., Ltd.; W. T. Henley's Tel. Works Co., Ltd.: General Electric Co., Ltd.; W. T. Glover & Co., Ltd.; Liverpool Electric Cable Co., Ltd.
Ebonite brushes, fibre, &c.—Spicer Bros., Ltd.; Mosses & Mitchell; Tramway Supplies, Ltd.
Rubber materials.—George MacLellan & Co.; Chas. Macintosh & Co.; I.-R., G.-P. and T. Works Co., Ltd.; Avon India-Rubber Co.
Insulating cloths and tapes —Ross & Co.; L. Andrew & Co.; Siemens Bros. and Co., Ltd.; W. T. Henley's Tel. Works Co.; St. Helens Cable and Rubber Co., Ltd.
Overhead line materials.—Brecknell, Munro & Rogers, Ltd.; Estler Bros., Ltd.; M. Bonser & Co.; Tramway Supplies, Ltd.; George Lister; British Insulated and Helsby Cables, Ltd.; W. B. Brown & Co., Ltd.

HEALTH DEPARTMENT.

Electrical fittings, &c.—Renton Holdsworth & Co., Ltd.; Taskers, Sons and Co.

The Council has also accepted the tender of Ferranti, Ltd., at £1,621, for switchgear at the Neepsend power house; also that of R. Waygood & Co., at £298 10s., for supplying and fixing an electric passenger lift at the Town Hall.

Stockport.—The T.C. has accepted the tender of the United Electric Car Co. for top covers for cars, at £120 10s.

Thurstonland.—The U.D.C. has accepted the tender of Messrs. John Mitchell & Sons, of Huddersfield, for wiring work, &c., at Storthes Hall Lane.

Toowoomba (Queensland).—The D.P. Battery Co. has secured the contract for the supply of a battery, with automatic reversible booster and switchboard.

Tunbridge Wells.—The T.C. has accepted the tender of the British Electric Transformer Co., Ltd., for four 50-KW. transformers.

Wallasey.—The Tramways Committee has accepted the tender of the Brush Electrical Engineering Co., for the supply of five new cars, at £664 each.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued :—

Commanding Officer—COL. H. M. LEAF.

Monday, March 13th.—"A" Company. Infantry drill, 7 to 7.30 p.m.; technical drill, 7.30 to 10 p.m.
Tuesday, March 14th.—"B" Company. Technical drill, 7 to 10 p.m. recruiting, 6 p.m.
Thursday, March 16th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, March 17th.—"D" Company. Recruits' infantry drill, 6.30 to 7.15 p.m.; technical drill, 7.15 to 10 p.m.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

Capacity of Condensers.—In a letter published in the *Electrical World*, Mr. B. O. Lenoir points out that in an adjustable condenser of the plug type serious errors may be introduced when a portion only of the capacity is employed, as the unused plates may be charged by induction. By varying the positions of the plugs, without changing the nominal capacity, the writer found it possible to neutralise the effects on the idle plates, and thus to obtain correct readings.

FORTHCOMING EVENTS.

Physical Society.—Friday, March 10th. At 8 p.m. At the Imperial College of Science. Papers on "Note on an Electrical Trevelyan Rocker," by Dr. W. H. Eccles; and "Notes on the Tilted Gold-leaf Electroscope," by Dr. G. W. C. Kaye.

South-Western Polytechnic Institute.—Friday, March 10th. At 7 p.m. Presentation of prizes and certificates by Sir A. Keogh, K.C.B.

Institution of Mechanical Engineers (Graduates' Association).—Monday, March 13th. At 8 p.m. Paper on "The Balancing of Engines," by Mr. A. J. Bremner.

Leeds University Engineering Society.—Monday, March 13th. Paper on "Utilisation of Exhaust Steam in Low-Pressure Turbines," by Mr. R. Sawers.

Royal Society of Arts.—Monday, March 13th. At 8 p.m. Cantor lecture on "Electric Heating," by Prof. J. A. Fleming. (Lecture II.)

Institution of Civil Engineers.—Tuesday, March 14th. At 8 p.m. Paper on "The Electrification of a Portion of the Suburban System of the London, Brighton and South Coast Railway," by Mr. Philip Dawson.

Illuminating Engineering Society.—Tuesday, March 14th. At 8 p.m. At the Royal Society of Arts. Resumption of discussion on "School Lighting."

National Electrical Manufacturers' Association (Inc.).—Tuesday, March 14th. At 2.30 p.m. At Balfour House, E.C. Meeting of the Council.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, March 14th. At 7.30 p.m. At the University, Manchester. Paper on "Electricity Meters," by Messrs. H. A. Ratcliff and A. E. Moore.

Faraday Society.—Tuesday, March 14th. At 8 p.m. At the I.E.E., Embankment, W.C. Papers on "Some Properties of Aluminium Anode-Films," by Messrs. G. E. Bairsto and R. Mercer; and "Surface Effects Between Mercury and Certain Solutions, and an Electrochemical Method of Estimating Dissolved Oxygen," by Messrs. S. W. J. Smith and W. F. Higgins; and other papers.

Institution of Electrical Engineers (Glasgow Local Section).—Tuesday, March 14th. At 8 p.m. At 207, Bath Street, Glasgow. Meeting.
Friday, March 17th.—At 8 p.m. At the Glasgow Technical College. Students' meeting.

Association of Mining Electrical Engineers (Newcastle Section).—Wednesday, March 15th. At 7.30 p.m. At the Armstrong College, Newcastle. Papers on "Oils for Transformers and Switches," by Mr. G. W. Humphrey; and "Considerations specially Relative to Small Colliery Installations," by Mr. T. Thomson.

Institution of Electrical Engineers (Students' Section).—Wednesday, March 15th. At 7.45 p.m. Paper on "Exhaust Steam Turbines," by Messrs. R. C. Plowman and E. F. Hetherington.

Institution of Mechanical Engineers.—Thursday, March 16th. At 8 p.m. Presidential address by Mr. E. B. Ellington.

Rugby Engineering Society.—Thursday, March 16th. At 8 p.m. At Benn Buildings, Rugby. Paper on "Facts and Figures," by Mr. E. B. Wedmore.

Royal Institution.—Saturday, March 18th. At 3 p.m. Lecture on "Radiant Energy and Matter," by Prof. Sir J. J. Thomson. (Lecture III.)

NOTES.

Parliamentary. — *Belfast Corporation Bill.* — The Examiner of the House of Commons has decided that Standing Orders have not been complied with in the case of the above Bill, which provides for the construction of tramways, &c., as the promoters were unable to prove the consent of the County Down County Council.

London Electric Railway Bill.—Before the Court of Referees on March 2nd, the London Electric Railway Co. opposed the petition of the Gordon Hotels Co. to be heard in opposition to the company's Bill, which proposes to make a loop railway so as to join up several of the tubes at Charing Cross. After hearing the parties, an agreement was arrived at by which the promoters undertook not to construct any tube railway in or near Northumberland Avenue.

Brighton and District Tramways Bill.—This Bill came before Mr. Jeune, Examiner, on March 2nd, for proof of compliance with Standing Orders, and was opposed by the Corporations of Brighton, Hove and Worthing, which alleged that, as their consent had not been obtained, the promoters had failed to comply with the necessary rules. On behalf of the promoters, it was contended that the consents of the Steyning Council, the Shoreham U.D.C. and the West Sussex County Council were sufficient to comply with the Standing Orders that consents be obtained in respect of two-thirds of a continuous line. The Examiner held that Standing Orders had not been complied with, and the Bill will accordingly have to go before the Standing Orders Committee, which will decide whether it shall be allowed to proceed.

London County Council Tramways Bill.—The Bill promoted by the London County Council came before Mr. Jeune, the Examiner, on March 2nd, for proof of compliance with Standing Orders. Mr. Sherwood was unable to offer proof of consent in respect of a number of the proposals, and accordingly the Examiner reported "non-compliance," and the Bill will have to go before the Standing Orders Committee for consideration as to whether it will be allowed to proceed. The proposals which will fall through owing to non-consent include tramways in Paddington, Hampstead, St. Pancras, Hackney, Islington, Chelsea and Kensington.

Cheaper Electricity for Lancashire.—Proposing the toast of "The Civic Authorities" at the annual dinner of the Manchester Association of Students of the Institution of Civil Engineers, on March 1st, Mr. J. A. F. Aspinall, general manager of the Lancashire and Yorkshire Railway, made an earnest plea for combination among the large towns in the vicinity of Manchester in the production of electricity. In Mr. Aspinall's opinion, there was no reason why Lancashire should be behind the neighbouring

county of Yorkshire, where electricity could be produced in large quantities at a farthing per unit. If a large amount of the wastage that resulted from the existing overlapping through each of the large towns and many private companies having their own separate supplies could be saved, there was no reason why electricity should not be produced so cheaply as to create an enormous demand for it not only in the coal mining, textile, bleaching and kindred industries, but also amongst tradespeople. It was an ideal which municipal authorities should keep before them.

Electric Iron Smelting.—Four additional iron smelters are being installed at Heroult, Cal. The original furnace has been in constant operation for some time, producing steadily about 20 tons of pig-iron every day.—*Electrical World.*

New Test for Arc Lamps.—A representative of the Union Electric Co. was recently erecting a number of Excello lamps at a works for a trial run against competitive makes, when a rope broke and let a lamp fall about 16 or 18 ft. on the wood block floor. With the exception of a slightly bent striking rod and a broken economiser, no damage was done, and the lamp was running in half an hour. The engineer endeavoured to induce the general manager of the works to apply a similar test to the competitive lamps to make a fair comparison between them, but probably this was not included in the specification. However, an order for 50 Excello lamps was the result.

The Coronation Exhibition at the White City.—Mr. S. Z. de Ferranti, the President of the Institution of Electrical Engineers, has accepted the invitation of the Duke of Teck to the chairmanship of the Electrical Engineering Committee of the above Exhibition.

Cape Town Electrical Exhibition Abandoned.—Owing to lack of support, says our Cape correspondent, the proposed Electrical Exhibition, which it was intended to hold about March or April, in the City Hall, has been abandoned.

State Telephones in France.—Commenting on a proposal of the French Government to make the supply of telephone apparatus a State monopoly, *l'Industrie Electrique* recently pointed to the disastrous effects of State monopoly upon the quality of matches, the railway service, &c., and vigorously protested against the suggestion. State products, it declared, cost three or four times as much as those of private firms, and were even then inferior to the latter. The result, it prophesied, would be to produce a dead silence in the exchanges, amid which the officials could slumber in peace.

Foreign Trade in February.—

Electrical goods imported £105,744, decrease £6,767.
Machinery imported £451,193, increase £136,054.
Electrical goods exported £225,728, increase £27,966.
Machinery exported £2,228,363, increase £308,548.

The total imports increased by £4,918,448, almost entirely in raw materials (the cotton imported increased by close upon that value).

The total exports increased by £3,961,250, the advance being well spread over a variety of wholly or mainly manufactured articles.

The Benefits of Gas.—As the result of experiments Dr. F. S. Toogood has published a eulogy of gas, and the daily papers are making the most of it, as usual. Frivolous persons might be tempted to make it the occasion of a play upon words, but we prefer to keep to the point, which is that gas lights and fires are alleged to be not only harmless, but surprisingly beneficial to health—*in rooms which are adequately ventilated.* Quite so—and is one room in a hundred, in which gas is burnt, adequately ventilated? The use even of *flueless* gas stoves in large rooms is approved as "economical," but proper ventilation is declared to be essential, and we quite agree with the proviso; as a matter of fact, the talented experimentalist has here out-Heroded Herod, for even the gas experts insist on the necessity of conducting the products of combustion up the chimney with scrupulous care.

Imperial College of Science and Technology.—In the course of an address at the prize distribution of the City and Guilds of London Institute, last month, Dr. Glazebrook referred to the splendid record of the Institute's Colleges, and to the successful development of the scheme for the organisation of an Imperial College of Science on the basis of the three existing institutions—the Royal College of Science, the Royal School of Mines, and the Central Technical College. He pointed out the importance of freedom for the staff to carry on research work, the necessity of eliminating elementary teaching from the syllabus, and the need of co-ordination between the various scientific teaching bodies of London, with the Imperial College as a central nucleus. Further, Dr. Glazebrook urged that it was essential that the group of institutions thus formed should have the power of granting degrees in technological science to its students, without reference to any external academic body.

Turin International Exhibition.—Arrangements are being made by the Board of Trade (Exhibitions Branch) to exhibit British chemical and physical apparatus in a novel and practical manner; at least two well-equipped chemical laboratories will be provided, in which various interesting processes will be effectively illustrated, and similar arrangements will be made for the display of scientific instruments and apparatus ready for work.

A large dark room will be provided for the accommodation of projection apparatus such as oscillographs, photometers, &c.

The organisation of these exhibits has been placed in the hands of Dr. F. Mollwo Perkin, under the direction of a sub-committee.

The Organisating Committee of the International Congress of the Applications of Electricity, to be held at Turin from September 9th to 20th, has issued a circular giving particulars of the arrangements made and an official list of subjects for discussion. The subscription of 20*s.* in advance carries the right to attend all meetings of the Congress, to vote, and to receive a copy of the printed *Transactions*; a member's relatives may attend the Congress (not voting) and take part in all the entertainments for a fee of 8*s.* Papers and proposals submitted by any member or electrical association will be considered by the Committee, and official reporters will be appointed to prepare concise papers on specified subjects, which must be received by June 30th. A French translation or summary should accompany each paper. Prof. L. Lombardi is the president of the Organising Committee, and Ss. G. Semenza and C. A. Curti are the secretaries, to be addressed at 10, Via San Paolo, Milan. A list of 31 subjects has been drawn up.

Electrical Fatalities.—A daily paper records that a woman climbed a ladder and deliberately hung on to electric wires, committing suicide, in the village of Charenay, Jura district.

It is reported that Peter Dawson, miner, Sauchie, was killed on Thursday last week, in the underground workings of Devonbank Pit, Alloa, he having accidentally touched a live electric wire.

Dangers of Gas Lighting.—As a sequel to the recent disastrous explosion near the Grand Central Station, New York, U.S.A., a municipal commission has informed the railway company that it will be necessary for them to "gas" their cars outside the borough of Manhattan in future. The danger lies in the possibility of explosion of the volume of gas that may accidentally be released in the tunnel from one of the tanks. The commission finds no evidence to modify the view that the damage was entirely due to a gas explosion.

American Electric Trust.—A Reuter dispatch from Cleveland, Ohio, states that on behalf of the Government a suit has been filed against the General Electric Co., of Schenectady (New York), and others, alleging unlawful combination and conspiracy in restraint of trade.

Electric Winding and Haulage Plant.—With reference to our article on the above in last week's issue, the British Electric Plant Co., Ltd., Alloa, N.B., write to say that they supplied the whole of the electrical plant for the winding and haulage gears, also the generators, a fact of which we were unaware at the time of going to press.

Institution and Lecture Notes.—Institution of Civil Engineers.—The nineteenth James Forrest Lecture will be delivered at the Institution on the evening of Wednesday, June 28th, by Mr. Frederick Henry Hatch, Ph D., M.Inst.C.E., his subject being "The Past, Present and Future of Mining in the Transvaal."

On February 28th a paper was read on "Modern Railway Signalling: Some Developments on the Great Western Railway," by Mr. A. T. Blackall.

The Concrete Institute.—At a meeting held last night, Thursday, the draft report of the Science Standing Committee on "The Rusting of Steel Inside a Concrete Covering" was under discussion.

American Society of Mechanical Engineers.—The meeting of this Society will be he held in Pittsburg, Pa., from May 30th to June 2nd. The Society has a membership of over 4,000 in America and abroad. The headquarters of the Society are in New York City, and Col. E. D. Meier, of St. Louis, is president this year.

Tramways and Light Railways Association.—The following new vice-presidents have been elected:—Lord Arthur Butler, Mr. Harmood-Banner, M.P., Mr. J. M. Henderson, M.P., and Councillor Jas. H. Rogers, chairman, Newcastle-on-Tyne Tramways Committee. The following have been elected members of the Council of the Association to fill vacancies:—Mr. R. L. Acland, manager and engineer, Chesterfield Corporation Tramways; Mr. W. Clough, general manager, Bury Corporation Tramways; Mr. C. H. Dade, secretary, British Electrical Federation, Ltd.; Alderman Wm. Ivey, West Ham Corporation Tramways; Mr. John Kennedy, Parliamentary agent. At the recent annual dinner it was announced that during the past year the Association had made a surplus of £80 over working expenses, which went towards paying off an old debt of £370, and that in addition donations had been received that evening from certain members which would completely pay off the debt and leave a substantial amount to the credit of the Association. A deputation consisting of the members of the Council of the Association was received by the President of the Board of Trade, the Right Hon. Sydney Buxton, M.P., on February 16th, on the subject of the reform of existing tramway legislation.

At Liverpool University last week Prof. E. W. Marchant delivered a lecture on the electrical age, when power would be exceedingly cheap, the Liverpool-Manchester railways would be electrified, ships would be electrically propelled, and even the weather would be to some extent electrically controlled.

Royal Institution.—In the first of his six lectures on "Radiant Energy and Matter," on Saturday last, Prof. Sir J. J. Thomson stated that on a bright sunny day the earth received energy from the sun at the rate of 7,000 H.P. per acre. The energy was not received in the form of heat; it might rather be called electricity, for all the methods used to detect and measure radiant energy depended upon absorbing it and transforming it into heat. The temperature of the sun was about 6000° C., and it radiated some-

thing like 15,000 H.P. per sq. centimetre of its surface, an appalling amount when the area of the sun's surface was considered. The production of this immense output of energy could not be accounted for by the presence of radio-active substances in the sun—not even if it were composed entirely of radium; a diminution of its diameter by 200 ft. per year, however, would account for the whole of it, and that amount of shrinking was almost as nothing in proportion to the vast bulk of the sun.—*Daily Telegraph.*

The following are among the lecture arrangements at the Royal Institution after Easter:—Mr. J. E. C. Bodley, Mr. T. Thorne-Baker, two lectures on (1) "Changes effected by Light"; (2) "Practical Progress in Wireless Telegraphy" (illustrated). The Friday evening meetings will be resumed on April 28th. Discourses will probably be given by Commendatore G. Marconi, Prof. Svante Arrhenius, and other gentlemen.

Association of Mining Electrical Engineers (Cumberland Branch).—At a recent meeting Mr. Williams remarked that the three-phase system was adopted to avoid sparking, and yet manufacturers persisted in using cast-iron slip-rings on motors, instead of gun metal. In the damp atmosphere which generally obtained in a colliery, a certain amount of oxidisation took place on the rings when the motors were standing, and when they started a motor again after a stoppage they naturally got fireworks.

A special meeting of the branch was held on February 18th, to hear an address by Mr. William Maurice, the President of the Association. He said that the fact of their having established 10 working branches, and enrolled nearly 1,000 members, in but little more than a year, was sufficient proof, if any proof was required, that the Association was formed at the right time. The installation of electrical machinery in mines had developed into an economic necessity. It had been forced upon mine-owners by the increase of the cost of mining coal, a very substantial portion of which increase had been caused by legislation designed for the protection of the workers. The use of electrical and other machinery enabled the mine-owner to meet, in some measure, these extra costs. It also aided the workers by increasing the number of workable properties. The extending use of machinery was rapidly eliminating the necessity for severe physical exertion, and, consequently, miners could perform a day's work with much less fatigue than formerly, and be better fitted for study and recreation when the wage-earning part of the day was over. It might be that the application of electrical power to mining purposes had brought with it new sources of danger to the workers, but there was absolutely no evidence to show that such new risks had increased the danger of getting coal. It was true that electricity had dangers of its own, but the application of electricity had lessened other kinds of risks to such an extent as to more than counterbalance those which it had introduced itself. Moreover, those purely electrical risks were rapidly disappearing. The mechanical improvements had all come about during the reign of the old type engine-wright; the consequence was that these men were finding themselves responsible for the charge of machinery which they did not understand, and the machinery had to suffer owing to the absence of sufficiently skilled attention. The advent of the electrician—of the class of man who could not properly perform his duties unless he were technically trained—had changed the condition of things, and the time was fast arriving when no colliery engineer would have a chance of holding a position unless he was properly trained for his work. Therefore it was that this Association—although started by the electricians—sought also to include the colliery engineer within its ranks. It was this diversity factor which had contributed to the success of the Association. He believed that the Association was capable of becoming one of the most useful organisations that had ever been designed in connection with the mining industry.

Copper.—The statistics of this metal for February, as set forth in Messrs. H. R. Merton & Co.'s circular, present several points of interest. Visible supplies in England, France and afloat, stand at 82,387 tons, a reduction of 806 tons since the end of January. As the average reduction, since the supplies began to fall off, has been 2,500 tons per month, this denotes a quiet period. The same indication is afforded by deliveries, which stand at 31,717 tons, as opposed to 42,390 in January. The withdrawals are made up of 925 tons less afloat (counteracted by an increase of 367 tons in British ports) and 248 tons less in French ports. The stocks in Rotterdam are the same, 7,600 tons, but those in Hamburg are estimated to have decreased 4,000 tons since January 31st. American stocks for the end of January actually show an increase of 9,112 tons over the returns for December 31st. The combined visible supply is, therefore (January 31st), 146,783 tons, an increase of 8,508 tons better than for the end of last year. English supplies from America are slightly down, made up for by the heavy supplies in January. Spain is up with 2,703 tons, the average being some 1,800. Chile shipments are average, and Australian, at 4,000 tons, slightly above. The annual quantity derived from this quarter is increasing in a healthy manner.

A Reuter dispatch from America says that the consolidation of nine subsidiary copper mining companies in Northern Michigan has been ratified by the stockholders of the Calumet and Hecla Copper Mining Co.

Electrical Fittings on H.M.S. "Invincible."—Lord Charles Beresford asked the First Lord of the Admiralty whether the electrical fittings for the gun mountings of H.M.S. *Invincible* had again broken down; whether these fittings had continually broken down after the guns had been fired; whether the ship had been placed in dock preparatory to taking out the whole of the electrical gun mounting fittings and replacing them by hydraulic machinery; and whether he would state the original cost of the electrical gun mounting fittings for the ship.—Mr. McKenna replied that certain of the electrical fittings for the gun mountings of the ship were not entirely satisfactory, and the contractors were effecting improvements at their own cost. It was not possible to separate the cost of the electrical gun mounting fittings from the total cost of the gun mounting machinery of the *Invincible*, which was the same as the cost of the gun mounting machinery for the *Inflexible* with hydraulic fittings.

Appointment Vacant.—"B" Class station supervisor, for H.M. Dockyard, Haulbowline, Co. Cork (42s.). See our advertisement pages in this issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—On Wednesday, last week, a presentation consisting of a marble timepiece and vases, was made to Mr. A. Garrick, mains engineer to the Ealing municipal electricity undertaking, by the staff and employés, on the occasion of his marriage. The presentation was made by Mr. J. Douglas Knight, the borough electrical engineer and manager.

Mr. T. H. Matthews has resigned his appointment as senior shift engineer at Port Elizabeth municipal electricity works, and has taken up an appointment with Messrs. Gould & Co., electrical engineers, Johannesburg.

The marriage took place on February 18th at Avon Dassett, of Mr. Percy Oliver, chief engineer and manager of the Midland Electric Light and Power Co., Ltd., of Leamington Spa, to Miss Philpott, daughter of the Rev. V. W. Philpott, of Avon Dassett.

The Woolwich T.C. has granted the following increases of salary:—Borough electrical engineer, an automatic increase from £375 to £400 per annum; Mr. S. H. Penning, distribution engineer, from £200 to £210; Mr. L. G. Butler, charge engineer, from £100 to £110; Mr. E. W. Martin, assistant distribution engineer, from £100 to £110; Mr. C. Hudson, charge engineer, from £80 to £90.

The Hammersmith B.C. is recommended by a committee to promote Mr. H. S. Broadway, chief clerk at the electricity works (nine years' service), Mr. J. H. Whyman, prime cost clerk (13 years' service), also Mr. T. H. Meacock, wages clerk (nine years' service), to the next higher class, they having reached the maximum in their present classes.

Mr. Francis Warwick has resigned his position with the Ilford Council, and leaves England on March 17th to take up an appointment in South Africa.

The Chester T.C. has increased the salary of Mr. S. E. Britton, electrical engineer to the Corporation, from £500 to £600 per annum by five annual increments of £20, such sum to be considered the maximum salary attached to the office.

Mr. H. A. Barnett, late resident engineer with the Clyde Valley Power Co., Glasgow, is now at the Commonwealth Edison Co.'s N.W. Power House, Elston and Roscoe, Chicago, Ill., U.S.A.

Mr. P. G. Campling, of Weymouth, has been offered the post of engineer-in-charge at the Bermondsey Electricity Works. He was previously at Middlesbrough, Bury St. Edmund's and Norwich.

The Leicester T.C. has appointed Mr. T. R. Smith, the tramways engineer, to be chief engineer and manager of the electricity department, and has increased his salary from £500 to £600 per annum. It has also appointed Mr. J. E. M. Stewart, the chief assistant engineer of the electric lighting department, to be assistant engineer of the electricity department at his former salary of £350 per annum.

Tramway Officials.—The Hull T.C. has increased the salary of Mr. Tarbett, of the tramway staff, from £200 to £225 per annum.

Mr. E. Cross, manager of the Rotherham Corporation Tramways, has been presented with a large framed photograph of himself, which will hang in the clubroom of the Tramway Men's Recreation Club, of which he is president. The employés chose this an an appropriate way of expressing their appreciation of Mr. Cross's help in forming the club.

Mr. A. S. Giles, formerly of Blackburn, and for some years manager of the electric tramways at Cape Town, has accepted a position at Lisbon at an increased salary.

General.—On Friday, February 24th, a large company of the Metropolitan North District Engineering Staff (Post Office) entertained the superintending engineer, Mr. E. Catley, and his assistant, Mr. J. Sinnott, to dinner. The occasion marked the retirement on superannuation of Mr. Catley and the promotion of Mr. Sinnott to superintending engineer of the N.E. district of Leeds. A capital musical programme followed, and during the evening the chairman, Mr. J. R. M. Elliott, proposed the toast of "The Guests of the Evening," and in wishing "God speed" to Mr. Catley, he mentioned the loss of one of the most genial and impartial officers under whom it has been a pleasure to serve. Referring to Mr. Sinnott, he congratulated the N.E. district on gaining a superintending engineer who, whilst thoroughly practical, had also a kindliness of heart which had endeared him to all with

whom he had been associated. The toast was responded to by Mr. Catley, who was in a happy reminiscent mood, and by Mr. Sinnott who foreshadowed a greater future for the engineering department.

Mr. J. C. M. Matthews, A.M.I.E.E., Government Electrical Engineer, Kuala Lumpur, Federated Malay States, is returning to the East on March 25th.

Mr. Charles Leven, M.I.E.E, managing director of the Lahmeyer Electrical Co., Ltd., informs us that he has now resigned his position as managing director of the said company, since its absorption by the A.E.G. Co.

Mr. Walter E. Gundry has resigned his position with the Electrical Power Storage Co., Ltd., and is now London manager of the Premier Accumulator Co., 53, Victoria Street, S.W.

Obituary.—Mr. J. Stottner.—We have learnt with great regret of the death of Mr. J. Stottner, which occurred on February 24th, in Dresden. Just before last Christmas the deceased gentleman, who had been in poor health for some time, went over to a Dresden sanatorium, and while there had to undergo an operation for serious internal trouble. Mr. Stottner will be remembered by large numbers of our readers in this and other countries for his very lengthy connection with the Electrical Co., Ltd., whose business in the United Kingdom he reorganised and conducted with remarkable success for many years. He retired from that sphere of activity two or three years ago, and after a short period of rest returned last year to electrical business in London, and was building up a new connection for the supply of electrical plant, &c., from offices here. There is not the least doubt that, aided by his valuable knowledge and experience of the requirements of the British market, his enterprising and energetic spirit, his wide circle of acquaintances, and his interesting personality, he would have succeeded equally well in his new concerns as in his old, had his health and strength of earlier years been continued to him. His wide knowledge of electrical industry in Germany and in England led him to certain very definite convictions as to measures which, if they could be applied, would assist British electrical engineering. He believed profoundly in the possibilities of concentrating one class of manufacture in one large works instead of undertaking the manufacture of a dozen classes in one factory. Many scattered works, making small quantities of a variety of things quite dissimilar in character, raised the cost of manufacture of each of these particular articles, and the chances of profit-earning were consequently small; whereas concentration of motors here, switchgear there, and something else somewhere else, and turning them out in bulk, both reduced the cost of manufacture and handling and increased the chances of profit and of business extension. Mr. Stottner, however, knew enough about English ways to appreciate that the carrying into effect of these ideas in a country where the scattered principle had developed as a gradual process in the hands of many private individuals and companies, who were each striving for their own success and had established themselves as part of a great industry, was a matter almost, though not quite, beyond human power. We all know of individual factories of comparatively recent establishment that are succeeding along these lines, but his idea implied a great reorganisation of older businesses. Whether time will bring about a measure of such reorganisation time alone can show, but we have thought it only right, in recording his demise, to indicate also his opinion as that of one who was undoubtedly at once both a far-seeing and a practical man of business. His British and foreign experience also led him to express strong views regarding the lack of the better salesmanship qualities among British electrical representatives, and he did not hesitate to say that what British industry needed a few years ago, more than anything else, was an altogether higher standard of salesmanship ability. His opinion on such a subject was not one to be lightly cast aside; those who knew him would understand that it was not mere prejudice that led him to express such a view. Mr. Stottner was only 51 years of age at the time of his death, so that his electrical record in this country consists of those 15 years of the best period of his life, devoted, as we have said, to the building up of a wide-spreading connection for the Electrical Co. as the British house of the A.E.G. It matters not what the nationality of a man, when there has passed away one of wide electrical industrial experience among us, the electrical world is the poorer for his loss.

Mr. Ernest Wilson.—The *Times* records the death of Mr. E. Wilson, a radiographer at the London Hospital, who, from 1899 onwards, took an important part in the development of the work of the X-rays branch there. Like so many others who experimented with the rays before the dangers were realised, he was a terrible sufferer from the disease which has gradually ended so many useful lives. He had to relinquish his post two years ago owing to the loss of several fingers, and after undergoing a number of operations, he passed away on March 3rd at the age of 40 years.

We regret to record the death of Prof. J. H. van't Hoff, which took place at Steglitz, near Berlin, on March 1st, in his 59th year.

The death occurred on March 2nd at Cross Hill, Morecambe, at the age of 65 years, of Mr. Christopher John Clark, who was chairman of the Lancaster and District Tramways Co.

Mr. Harold E. Harrison.—We deeply regret to learn of the death, at the very early age of 37 years, of Mr. H. E. Harrison, who for the last nine years has occupied the position of secretary of Callender's Cable and Construction Co., Ltd. The deceased gentleman was engaged with his accustomed duties at the office of the company on Tuesday of last week, but feeling very unwell, left early. On the following Saturday he died, the cause of death being double pneumonia. The funeral took place on Tuesday, March 7th, at Streatham. The entire office staff were present to pay their last respects, as were also Mr. Tom Callender, managing director, Mr. Petersen, assistant manager, and Mr. Walker, works manager.

CITY NOTES.

City of London Electric Lighting Co., Ltd.

The directors' report for 1910 states that the capital expended during the year was £50,338 for additions, extensions and replacements. There has been written off in respect of buildings, plant and other works dismantled during the year 1910 a further £44,270, so that the net expenditure as at December 31st, 1910, stands at £2,147,425, a net addition during the year of £6,069. The directors have credited the first debenture stock premium redemption account with £1,407 from revenue for interest, raising the amount at the credit of the redemption account at December 31st, 1910, to £60,044. They have also transferred £45,000 from net revenue account to reserve account. The balance at credit of reserve account as at December 31st, 1910, stood at £262,808, in addition to which there were first debenture stock premium redemption account, £60,044; leasehold redemption account, £3,993; standing reserve for doubtful debts, &c., £2,155; dividend equalisation account, £14,000; amount proposed to be carried forward to 1911, £27,657—total reserves, £370,657.

The total revenue for the year was £280,116, plus interest on investments and discounts, £2,013. From this must be deducted:—Expenses of generation and distribution, £64,040; repairs and maintenance of buildings, machinery, plant, mains and other works, £11,772; rent, rates, taxes, management expenses and special charges, £49,561; leaving £156,755, plus £25,668 brought forward. Making a total available revenue of £182,424. Interest on loan from bankers, consumers' deposits, &c., requires £3,030; interest on first and second debenture stock for year 1910, £31,546; interest transferred to debenture stock premium redemption account, £1,407; leasehold redemption account, interest and appropriation, £251; staff superannuation fund, £369: stores, written down, £30; transfer to reserve account, £45,000; leaving available for dividends on preference and ordinary shares and for carry forward to 1911, £100,790. The directors now recommend for the year 1910 dividends as already announced in these columns absorbing £69,134, also that £4,000 be transferred to dividend equalisation account, and that £27,657 be carried forward. The following are the comparative statements:—

Revenue.	Dec., 1908.	Dec., 1909.	Dec., 1910.	Decrease from 1909.
Gross revenue from all sources	£283,239	£288,161	£282,129	£6,032
Net revenue available for reserve, interest on debenture stock, &c., dividends and special charges	£153,387	£160,656	£156,755	£3,901

Private Supply: Average Price Obtained.		
In 1908.	In 1909.	In 1910.
2·55d.	2·49d.	2·45d.

The following show the total customers and connections (private supply):—

	Dec., 1908.	Dec., 1909.	Dec., 1910.	Increase over 1909.
Customers being supplied	12,882	13,338	13,876	538
KW. connected (including power and heat)	35,468	35,915	37,127	1,212

On February 15th, 1911, there were 38,707 KW. applied for, out of which 37,408 were connected, and the customers numbered 13,954. The following are the total units generated, sold, utilised on works, &c. (including public street lighting):—

	1909.	1910.
Generated	29,146,295	28,939,348
Sold	25,454,485	25,183 380
Metered and used by company	864,403	1,022,253
Expended in distribution	2,827,407	2,733,715
Maximum supply demanded, KW.	19,288	17,767

The total units sold during 1910 show a decrease of 271,105 from the quantity sold during 1909.

The power and heating supplies continue to show a steady increase, the total sold for these purposes in 1910 being as follows: Power, 7,142 882 units; heating, 1,393,845 units = 8,536,727 units, together being equal to 35·6 per cent. of the total units sold for private supply.

The demonstration of improved electric lighting carried out by this company by means of flame arc lamps suspended across Cheapside, of arc lamps on standards down the centre of Farringdon Street, and of metallic filament lamps in various side streets, has been in operation for some months and has met with general approval. The whole question of the street lighting is still under consideration by the City Corporation. The special expenditure on the demonstration amounted during the past year to £2,272, which sum has been placed to a suspense account for the present.

The route of the proposed new St. Paul's Bridge, if carried out as planned, will interfere with the company's Bankside property, and the directors will, therefore, strenuously oppose the City of London (Bridges) Bill in its present form. The directors are also taking such steps as are necessary for the protection of the company's interests in connection with other Bills now before Parliament.

North Metropolitan Electrical Power Distribution Co., Ltd.

The directors' report for the year ended December 31st, 1910, shows that the revenue amounted to £14,519, an increase of £2,016. After deducting all expenses chargeable to revenue, including

£1,243 for interest upon debentures and loans, there remains a surplus of £3.683, making with £148 brought forward, a total of £3,831. A dividend at the rate of 4 per cent. per annum is to be paid absorbing £2,000, there is to be placed to the credit of the depreciation account £1,500, and to be carried forward £331. The expenditure upon capital account during the year amounted to £2,574. The Enfield sub-station buildings, machinery, accumulators and furniture therein have, however, as from September 30th last been taken over by the North Metropolitan Electric Power Supply Co., and in consequence the amount of this account at December 31st has been reduced by £7,922 to £65.247.

The revenue for the year from the Barnet electric supply amounted to £5,490, compared with £5.123 during 1909. The installations connected to the mains at December 31st last were approximately equivalent to 18,900 30-watt lamps. The revenue for the year from the Enfield electric supply amounted to £3,080, compared with £2,556 during 1909. The installations connected to the mains at December 31st last were approximately equivalent to 14,700 30-watt lamps. The revenue for the year from the Hertford electric supply amounted to £3,467, compared with £3,165 during 1909. The installations connected at the mains at December 31st last were approximately equivalent to 17,000 30-watt lamps. The revenue for the year from the St. Albans electric supply amounted to £2,482, compared with £1,607 during 1909. The installations connected to the mains at December 31st last were approximately equivalent to 19,900 30-watt lamps. The new connections made during the year to the mains in the four districts represented the equivalent of 9,061 30-watt lamps, making the total connection at the end of the year of approximately 70,500 lamps. The number of units sold during the year was 1,027,365, which, compared with the previous year's figure of 847,543, is an increase of 21 per cent. The retiring director, Mr. George Offor, offers himself for re-election.

	Barnet.	Enfield.	Hertford.	St. Albans.	Total.
Purchased in B.T. units ..	478,624	225,042	229,320	211,202	1,144,188
Sold—Public lamps ..	53,819	—	6,577	—	60,396
By contract	256,240	49,441	39,097	118,988	463,766
Private consumers by meter	128,101	127,410	166,139	81.553	503,203
Total sold	438,160	176,851	211,813	200,541	1,027,365
Used on works	—	29,269	—	—	29,269
Total accounted for ..	438,160	206,120	211,813	200,541	1,056,634
Total not accounted for ..	40,464	18,922	17,507	10,661	87,554
Public lamps	200	—	30	—	230
Max. supply demanded ..	303 KW.	154 KW.	158 KW.	191 KW.	—

Bournemouth and Poole Electricity Supply Co., Ltd.

THE directors' report for the year ended December 31st, 1910, states that the capital expended during the year on account of the Bournemouth Order, 1890, the Poole and Branksome Order, 1897, the Christchurch and District Order, 1899, and the Pokesdown Order, 1902, amounted to £9,256, making the total expenditure on account of these orders up to December 31st last £452,457. The balance from revenue account, after deducting generation and distribution costs, rent, rates, taxes, wages, directors' fees, general establishment and other charges, and proportion of salaries, is £34 892 plus £1,077 brought forward. There is thus a total available revenue of £35,969 from which are deducted interest on debenture stock and interest on temporary loans, less income-tax, £8,606; interim dividends on 7,500 4½ per cent. preference shares, and on 15,000 6 per cent. second preference shares for half-year ended June 30th, 1910, less income-tax, £5,827; interim dividend on 15,000 ordinary shares at 5 per cent. per annum for half-year ended June 30th, 1910, less income-tax, £3,531; leasehold and special redemption funds and interest, £1,628; amount written off suspense accounts, £413; carried to reserve for depreciation, repairs, renewals, &c., £4,500; leaving for distribution, £11,464. After allowing for the second instalments of the preference dividends, it is recommended that a final dividend on the ordinary shares for the half-year ended December 31st, 1910, at the rate of 6 per cent. per annum, less income-tax, be declared. This will leave a balance of £1,400 to be carried forward. The total applications received at December 31st last amounted to the equivalent of 236,569 30-watt lamps (7,097 KW.), being an increase of 13,413 (402 KW.) for the year. The total units sold for all purposes was 3,062,238. The total units sold in 1910 was 2,973,487. The directors of the Richmond (Surrey) Electric Light and Power Co., Ltd., have declared a dividend of 6 per cent. on the ordinary shares for 1910, the same as for 1909.

Davis & Timmins, Ltd.

THE report of the directors for the year ending December 31st, 1910, states that the net profit, including £7,228 brought forward, after allowing for depreciation and commission to manager, is £18,581. The interim dividend paid in September last on the preference shares absorbed £1,800, that on the ordinary shares at the rate of 6 per cent. per annum for the half-year to June 30th, 1910, £1,410, and there has been placed to general reserve account the sum of £2,000, leaving a balance of £13,371 to be dealt with. The directors propose a six months' dividend on the preference shares, at 6 per cent. per annum to December 31st, 1910, £1,800, a balance dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year to December 31st, 1910, making 8 per cent. per annum for the year, £3,860; a bonus of 2½ per cent. out of accumulated profits, £1,175; leaving to be carried forward, £8,046. Mr. G. E. Timmins, who has for many years been associated with the business, has been appointed a director of the company.

Mackay Companies.—The report states (says the *Financier*) that the new trans-Continental lines have been completed by construction from Reno, Nevada, to Salt Lake City, Utah, and by construction from Seattle to Spokane, Washington. These lines enable the Postal Telegraph Co. to give the best of service between the Pacific Coast and the East. Heavy copper wires on these lines were transposed when erected, so that they are now used for telegraphing and telephoning simultaneously. In the ocean system a new additional submarine cable has been laid from Waterville, Ireland, to Weston, England, with underground connection to London. The eastern ends of two of the Commercial Cable Co.'s cables from America to Europe have been replaced by new heavy cables to withstand the action of the fishing trawlers off the Irish coast, and a long section of the cable from Waterville to Havre, France, has also been renewed. The replaced cabled in both cases has been in use over a quarter of a century.

Galloways, Ltd.—The directors' report (as abstracted in the *Financier*) states that the past year was a very trying one in all branches of the engineering trade covered by the company's business. The scarcity of engine orders resulted in competition so keen that prices were unremunerative throughout the period. The Lancashire boiler trade has been completely demoralised; while the price of raw material has risen appreciably, the selling price of finished boilers has been lower than ever before. The company have patented a new type of drop valve, and several large engines on this principle are in course of construction at present. The company have also introduced a new superheater and a new furnace, which in the short time they have been upon the market have met with a ready sale, and a large business is expected to develop rapidly. The costs of production have been further reduced at both works, and the efficiency of the same improved, so that, with any return to the normal state of trade, the directors feel confident that the result of the company's operations will be very different from that now presented. The result for the last year, after payment of the debenture interest (£6,000) and depreciation allowance of £3,448, shows a loss of £9,403, increasing the deficiency account

Telegraph Construction and Maintenance Co., Ltd.—Lord Selborne presided at the ordinary meeting, held on February 28th, at the offices in London. In the course of a brief statement (in which he moved the adoption of the report and the payment of dividend, making a total of 20 per cent. for the year) the chairman said that in the balance-sheet on the credit side property, stocks, &c., stood at a considerably reduced figure, as a year ago there was much cable in the works, manufactured, but not delivered. The North Woolwich property had been sold and that also had affected the same item, but the proceeds had been added to reserve.

Direct Spanish Telegraph Co., Ltd.—The board recommends, in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, a dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended December 31st, 1910, and payable on April 1st.

Fife Tramway, Power and Light Co.—In the report of this company, it is stated that the profits for the year ending December 31st, with the balance carried forward, after providing interest on debenture stock, amount to £11,190, from which is deducted interim dividend paid on the preference shares for the half-year to June 30th, leaving a balance of £7,340. The directors recommend a dividend on the preference shares for the half-year to December 31st, at the rate of 6 per cent. per annum, leaving £3,590 to be carried forward.

Prospectus.—*The London Electric Railway Co.*—The list closed last Saturday in an offer by Messrs. Speyer Bros., of £1,250,000 4 per cent. preference stock at 82¼. The proceeds are to be used to redeem the 5 per cent. prior lien bonds.

Canadian General Electric Co., Ltd.—The directors have declared a quarterly dividend of 1¾ per cent. on the common stock for the three months ending March 31st.

British Insulated and Helsby Cables, Ltd.—The directors announce a dividend of 6s. per share (making 10 per cent. for the year), £36,000 is carried to reserve and depreciation and £42,000 forward. For 1909 the dividend was at the same rate.

Globe Telegraph and Trust Co., Ltd.—The directors have declared quarterly dividends of 3s. on the preference stock and 2s. on the ordinary stock.

Stewarts & Lloyds, Ltd.—The directors, after setting aside £70,000 for depreciation and paying preference dividend, have declared a dividend at the rate of 10 per cent. per annum on the preferred ordinary shares, and a dividend of 1s. per share on the deferred shares for the year, placing £32,155 to reserve fund, and carrying forward £83,060.

Sao Paulo Tramway, Light and Power Co.—A quarterly dividend of 2½ per cent., payable April 1st, is announced.

Held Over.—A number of reports and meetings of electrical companies have to be held over until next week, owing to heavy demands upon our space.

Northampton Electric Light and Power Co., Ltd.

THE annual meeting was held at the Town Hall, Northampton, on Thursday last week, Mr. F. H. Thornton, J.P., presiding.

In moving the adoption of the annual report (see ELECTRICAL REVIEW, p. 269), the CHAIRMAN said that the year's work had been very satisfactory. It was not always that a company was able to increase its capital, as the company had done during the year, and at the same time pay an increased dividend. The chief feature of the accounts was the fact that they had an increased revenue from the sale of energy, amounting to £2,923, an increase of something like 40 per cent., and they had done that at an increased expenditure of only £1,013. Of that amount quite £500 had been spent in putting the engines into an efficient and thorough state of repair, and the engines were now all practically as good as new. They had sold over half-a-million more units of energy, and increased their cost of coal by only £78, which was an excellent testimony to the efficiency of the new plant that had been put in for coal handling and stoking, and for dealing with the exhaust steam. A good deal of capital had been spent in that way, but they were now reaping the benefit in low coal cost and a big sale of energy. It was being extensively used in factories and was now being taken up in the dwelling houses of the artisan class. In the factories the use of electricity must make for improvement in health conditions, while in private houses it meant a great saving in the cost of decorations. The directors had ordered a new engine and boiler and intended further to extend the plant. He hoped that when subscriptions to a new issue were invited, it would be taken up and that the company would pay a dividend on the money.

Seconding the proposal of the chairman, ALD. W. JONES, J.P., said that a slot meter system had been introduced for the benefit of artisans who wished to use electric light.

The motion was adopted.

Supporting a vote of thanks to the staff, the CHAIRMAN spoke highly of the loyalty of the employés. More than once notice had been received at 5 o'clock in the evening to connect a factory, and by working all night the staff had had everything ready for the factory to commence work at 6 o'clock the next morning.

Newcastle and District Electric Lighting Co., Ltd.

THE annual meeting was held on March 3rd. MR. JOHN B. SIMPSON, D.C.L., in moving the adoption of the report (see ELECTRICAL REVIEW, page 357), said they would observe that the net profit showed an increase of £1,002, and it would assuredly have been greater but for the bad effect of strikes and lock-outs. It was pleasing to observe that the extra profit was earned although their costs were considerably more during the 12 months. For the present year, if no unforeseen labour or other trouble arose, the results should prove more satisfactory.. As evidence of this, he stated that for the month of January, 1911, their profits had been considerably more than at the end of January, 1910, and generally the outlook was better. The demand for electrical energy, both for lighting and power purposes, continued to increase, and during the next few weeks, in addition to other installations, a large colliery pumping plant would be coupled to the mains. The low cost of electric lighting, due to the use of metal-filament lamps, had greatly popularised that method of illuminating shops, houses, &c., so that they were able to report a slight increase in the higher-priced units, instead of a falling-off in that part of the business, which had been the case during the last few years; that was due both to new consumers and a more extended use of the light by old consumers. The Newburn station was yielding better results, and there was every reason to believe that, with the improvement of trade in that district, it would further improve this year.

SIR BENJAMIN C. BROWNE seconded the adoption of the report, which was carried unanimously.

The dividend resolution was passed, and the usual other business transacted.

W. T. Henley's Telegraph Works Co., Ltd.

THE directors' report for the year 1910 states that the accounts show a net profit of £77,566. After payment of directors' and auditors' fees and debenture interest, and making allowance for depreciation of buildings, plant, machinery, &c., there remained £52,059, making, with £32,396 brought forward, a total of £84,455. The directors have transferred £10,000 to the reserve account, have made a reserve of £6,394 in respect of Consols and other trustee securities, and recommend the payment of a dividend on the ordinary shares of 15 per cent., free of income-tax, of which an interim dividend of 5 per cent., free of income-tax, was paid on September 1st. These payments will, together with the preference dividend for the year, amount to £57,144, leaving a balance of £27,311 to be carried forward. The dividend warrants for the ordinary shares will be posted on March 10th, 1911. The directors record with deep regret the death of their esteemed colleague Mr. B. T. Finch; they have elected Mr. Martin Roberts, M.Inst.C.E., to fill the vacancy.

Brompton and Kensington Electric Supply Co., Ltd.—The directors after crediting depreciation account with £1,707, and carrying to reserve fund £8,000, have declared a final dividend on the ordinary shares at the rate of 11 per cent. per annum, making 10 per cent. for the year, carrying forward £7,443. For 1909 the dividend was at the same rate.

Llandudno and Colwyn Bay Electric Railway Co., Ltd.

WE have received a printed report of the meeting held at Basildon House, E.C., on February 20th.

MR. A. W. TAIT, who presided, in moving the adoption of the report for the year, said that the traffic receipts showed an increase of £452, and considering the general depression and the bad weather in the summer months, the increase was satisfactory. The whole of the fares and stages had been reorganised, and it was anticipated that they would benefit. The power expenses were £3,004 for 1910, against £2,520; traffic expenses, £2,027, against £2,488; repairs and maintenance, £980, against £1,114; general expenses, £3,126, against £2,184; interest on loan was £2,089, against £1,675. Altogether the expenses were £11,301, against £10,001, plus £3,612 and £4,436 balance to appropriation account in the two years, making £14,913 for 1910 and £14,437 for 1909. The total available balance was £3,821, which was applied thus:—Depreciation reserve (making £2,000), £750; writing off expenses of loans, £713; carry forward, £2,328. Funds were required for doubling the track of the Rhos-on-Sea Estate and for the repair of certain portions of the route. The matter was urgent, as it was almost impossible to cope with the exceedingly heavy traffic of the summer months. As regarded the old Colwyn extension, negotiations were still in progress with the Colwyn Bay Council, and if the extension could be carried out at reasonable cost it would be beneficial to residents and to the company. They had offered what they felt to be the maximum contribution toward widenings, and were ready to proceed with the extension immediately the Council agreed to their proposals. Mr. George Balfour had joined the board. Messrs. Stephen Sellon and J. E. Touche had resigned from the board, and their seats were not to be filled. The chairman gave the following statistics of the business for the two years:—

	1910.	1909.
Car-miles run	260,872	247,843
Passengers carried	1,424,045	1,356,329
Ditto per car-mile	5·46	5·47
Traffic revenue, per car-mile	13·55d.	13·82d.
Average fare per passenger	2·48d.	2·53d.
Expense ratio	62·06 %	57·67 %
Number of cars	18	18

MR. G. BALFOUR seconded the adoption of the report, which was adopted.

County of London Electric Supply Co., Ltd.

THE directors' report for the year ended December 31st, 1910, states that the capital expended during the year on account of the company's London districts amounted to £60,141. The net total expenditure in respect of those districts up to December 31st last amounted to £1,764,100. The balance from revenue account, after deducting generation and distribution costs, rents, rates, taxes, wages, directors' fees, general establishment and other charges, and proportion of salaries, is £110,930, plus £3,163 brought forward, making a total available revenue of £114,093; interest on the first and second debenture stock (including £39,495 first debenture stock sold during the year) and interest on temporary loans to December 31st, 1910, less income-tax, absorb £42,827; interim dividend on preference shares for June half-year absorbed £15,537; interim dividend on ordinary shares at 4 per cent. per annum for June half-year, £7,533; carried to reserve for depreciation, repairs, renewals, &c., £20,000; leaving for further distribution £28,195. The directors now recommend the last half-year's dividend on the preference shares, and a further dividend on the ordinary shares at the rate of 6 per cent. per annum for the last half, be declared, leaving a balance of £1,358 to be carried forward.

The applications received during the past year amounted to the equivalent of 3,760 KW., as compared with 3,221 KW. for 1909. The total units sold were 16,985,687, being an increase for the year of 2,249,578 units, or over 15 per cent. The shareholders will be asked to consent to an increase of the company's borrowing powers from £1,000,000 to £1,200,000, in order to place the directors in a position to obtain temporary advances as the development of the company's business may require. The directors of the Bournemouth and Poole Electricity Supply Co., Ltd., have declared dividends on the ordinary shares, making 5½ per cent. for the year. The business of the Coatbridge and Airdrie Electric Supply Co., Ltd., continues to make good progress. There is an increase of 827 KW. applied for, and an increase of 639,653 in the units sold during the year, raising the total sales to 2,692,028 units.

Units generated	22,899,332
Sold—Private consumers by meter	16,985,687
Total sold	16,985,687
Used on works	1,831,523
Accounted for	18,817,210
Unaccounted for	4,022,122
Total maximum supply demanded, KW.	10,350

Aberdeen Suburban Tramways Co.—For the half-year ending January 31st, 1911, the profit earned amounts to £1,381, making, with the sum carried forward from last half-year's accounts, a balance of £1,889 at the credit of profit and loss account. The directors regard the result of the half-year's working as satisfactory. They recommend that the sum at the credit of profit and loss account should be carried forward, as usual at this time. To meet the growing demands of the company's traffic, the directors have placed an order for an additional car with the Preston Car Co.

Chelsea Electricity Supply Co., Ltd.

The annual meeting was held on Monday at Winchester House, E.C., Sir Irving Courtenay presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, page 359), said it was a pleasure to be able to recommend the slightly higher dividend of 5 per cent. for the year, and the more so as it was fully earned, both the gross and the net revenue showing progressive increases since and including the year 1908. The gross revenue showed an increase of £2,300 on that for 1909, while the costs were only £500 more, the percentage of expenses to receipts being a little less. The net revenue was, therefore, £1,800 more. After paying the dividend they were able to carry forward £936 more than last year. The balance of debtors over creditors showed an improvement of £940, and the cash position, including investments, was better by £9,880. The investments now stood in the balance-sheet at £27,783. The lamps added to their circuits numbered 10,957, a somewhat larger number than had been added during each of the three previous years. Most of the new lamps were the metallic-filament lamps, which were still being adopted gradually; it had, consequently, not been necessary to provide new machinery to any extent, and the capital expenditure had been small. The actual amount of capital expenditure was £5,199, a large portion of which was on mains. This amount was about £1,400 less than the actual capital expenditure in 1909. In a district like Chelsea, where leases were continually falling in, the condition of the building trade, which formerly gave them much larger yearly increases of lamps, was a subject always in their minds. He was not yet able to report favourably on the matter. By persistent and widely-spread canvassing, coupled with appropriate literature and an exhibit of samples, they had not only increased their lamp connections by a reasonable figure, but had secured an addition to the power load, which was very fair for what was mainly a residential area. He referred at this time last year to the effect of the introduction of the new metal-filament lamps in reducing the electric lighting accounts of some of their customers, and expressed the belief that in the long run the change would not operate detrimentally to their business. Up to the present nothing had occurred to cause him to alter his views on this important subject. The change, so far as Chelsea was concerned, had been taking place gradually, and although they would certainly feel its effects for some time yet, he thought he would be safe in saying that there was hardly a consumer in their area who was not now using the new lamps to some extent, or, at any rate, who did not know that they were obtainable if he wished to use them. It was, of course, always possible that lamps of still greater efficiency might be introduced, or that a reduction in the price of the lamps might lead to their being adopted to a still greater extent; but, in view of their past experience, he had very good reason to hope that the new business which they were able to secure would at least neutralise any falling off in lighting accounts of present consumers due to the increased use of metal-filament lamps. Their Parliamentary expenses were very small, and they hoped to keep them at a low figure. They were never free from attacks of some kind on their business, and this year there were two Bills, the Metropolitan District Railway Bill and the London Electric Railway Bill, asking for powers for supplying electricity, and these it would be necessary to oppose. As, however, it was expected that all or most of the London Electric Supply Companies would join in the opposition, it might be presumed that their share of the expenses would not be large. Towards the end of last year they ascertained that the Chelsea Borough Council were entertaining a suggestion from the gas company that their existing contract for street lighting by gas should be terminated, and that the Council should enter into a new contract for gas lighting in the streets for a further term of years. They at once approached the Council, and asked to be allowed to tender in competition with the gas company. Although the price per annum which they tendered was lower than that of the gas company, the contract was given to the gas company for a further period of seven years. They considered that they had not been fairly treated in this matter, and wrote a letter to the Council, submitting that on a future occasion they should be allowed to tender for the street lighting on equal terms with the gas company, and the letter was published and commented upon in the local newspapers and elsewhere in the public Press. The coming season, with the various festivities and functions attendant on the Coronation of the King, promised to be a very brilliant one, and it should have a favourable effect on many London businesses, their own included. But there was another circumstance which should benefit them during the next few years. By the quinquennial valuation of 1905 their assessment was nearly doubled, their contribution to the rates jumped from about £3,000 to nearly £6,000. This was an important factor in the reduction of the 1906 dividend. During 1910 there had been another valuation, and although their assessment was first put up by £2,000, it was subsequently, on appeal to the borough council, reduced to an amount somewhat below the assessment of 1905. The situation was therefore favourable in more than one respect. The steady increase of revenue from year to year was gradually neutralising the adverse circumstances. The standing charges had not been increased by the re-valuation. The effect of the metallic-filament lamps had been partially overcome. The issue of fresh capital had not been necessary for several years. If, therefore, they could see a normal increase in their revenue, with their capital issued standing at the same figure, it seemed to him that they might fairly hope to maintain, and even somewhat improve, the present position. In regard to the so-called Daylight Saving Bill, whether that was likely to become law or not they were as well able to judge as he was. In any case, they could safely leave that out of account until it was more within the bounds of practical politics. The London Electric Supply Act, 1908, was under consideration generally in regard to bulk supply, but so far as the Chelsea Co. was concerned no definite decision had as yet been arrived at.

Mr. H. R. Beeton seconded the motion.

Mr. Makins said the chairman had touched very briefly on a very important topic—the London Electric Supply Act of 1908. That Act gave the companies power to work together, and he thought it was going to be a panacea for all their ills. It was three years since the Act was passed, and, as far as he could gather, their company had done nothing. He would like to know whether that was due to the supineness of the directors or to engineering difficulties?

The Chairman said that the 1908 Act was largely a question of bulk supply. As far as they were concerned, they would be only too glad to enter into an arrangement for the purchase of a bulk supply, if they could do so at a moderate cost; but, so far, that had not been possible.

Mr. H. R. Beeton said that the advantages of the 1908 Act which were recognised by Parliament and the public at the time it was passed were in the nature of the case prospective. There was no immediate necessity for any existing company to link up with any other company or authority, unless for the purposes of a standby. Therefore it need occasion no surprise that in an interval of three years little or nothing had been done in that direction. There was this further consideration—that the purpose of the Act was to inaugurate as soon as possible a uniform system of supply—a general linking up, and any system of a general character must necessarily involve a uniform engineering basis which was an exceedingly difficult matter to arrive at. That question had been and was still receiving the consideration of a special Committee appointed by the companies and the municipal authorities, of which he (Mr. Beeton) was a member, and also of a sub-committee of eight engineers who had already reported more than once, but who had not yet promulgated any definite plan. Everything had been done of a preliminary nature which could be done, but the time had not arrived when it would be any advantage to do anything in the nature of a bulk supply. It was reasonable to hope that in the future a different state of things would prevail, and, of course, if they could obtain a cheap bulk supply they would take it. He wished to make it quite clear that no loss had been sustained by so little having been done up to the present time of a definite character.

The report was adopted.

Kensington and Knightsbridge Electric Lighting Co., Ltd.

Colonel R. E. Crompton, C.B., presided on March 2nd over the twenty-fourth ordinary general meeting of the above company, held at the offices, 148, Brompton Road, S.W.

The Chairman, in moving the adoption of the report (see Electrical Review, page 304) said that he thought they would consider the position satisfactory; in spite of various set-backs which they had experienced during the last two years, they had made some advance. The output of the year had increased from 5,641,000 to 5,974,000 units. This increase was in spite of the introduction of metallic-filament lamps; but a considerable portion of it was due to the power load in connection with certain large contracts which during the year had been carried on in their district, and which could not be continued. On the other hand, although it was most unsafe to prophesy, they believed that now the public had appreciated the great increase of light they got by the use of metallic-filament lamps, more was now used by individual users than they had hoped for in their previous reports. Turning to the expenditure account, it would be seen that, in spite of the large increase in the units, the increase in the cost of generation had only been from £23,951 up to £24,101, and this they might consider wholly satisfactory. It was chiefly due to the increasing economies at the Wood Lane works, and here again this result had been obtained partly by increase of output which to some extent reduced the incidence of the standing charges, but also from the increasingly efficient use of the more modern plant which had reduced the amount of coal per unit generated, and the cost of repairs had also been kept down. In distribution costs the increase had been from £6,246 to £6,862, about £600, the only increase of importance being in the amount expended on upkeep of mains. On the next item, rates, rents and taxes, he had always been compelled to remark on the heavy incidence of local taxation. They had an unending struggle with the local authorities in this respect, and had been able to obtain a reduction in their assessment, although not as much as they had hoped for, and a small portion of this, amounting to £602, appeared in the accounts, but the full effect of the reduction would not come into force until next year's accounts. There had been a slight increase in general establishment charges, principally due to the establishment of a showroom, the cost of which was debited to revenue under this head. Law expenses continued to be considerable. As last year, so this year, the item of £668 in the accounts was mainly due to their struggle to obtain a reduction in the assessment. After deducting, as usual, the amount actually spent on repairs and maintenance of plant, they had been able to put to the increase of the renewal fund the substantial sum of £10,836, which was a notable figure, and brought the total of their reserve and renewal fund to £96,084, so that if they were able, as they expected, next year to adhere to their usual custom in this respect, they would see this fund equal to their ordinary share capital. The balance carried to net revenue showed a net increase of £834, which was principally due to the

amount by which they had succeeded in reducing the rates. Although their total share capital and debenture stock added together amounted only to £295,000, the total expenditure up to December 31st was £385,220, so that they had expended £90,220 in excess of the capital received This, of course, was represented by the reserve fund. The amount of £8,000 which was last year shown to be borrowed against deposited debenture stock security had been repaid. In regard to the indicated value of the company's undertaking as shown by the total of £385,220 shown on the debtors' side, the shareholders would notice that a very large proportion of this was in mains, land and buildings which were unlikely to be depreciated to any serious extent. As regarded the machinery, this had its full value for the purposes of the undertaking as a going concern, but deductions would have to be made on account of what engineers called "antiquation"—that was that the same plant to carry the same output could now be purchased at a less figure. On the other hand, it was doubtful whether, on account of various causes, the mains could be put down now for the sum shown in the balance-sheet. It was difficult to balance these items against one another, but as this element of uncertainty existed in the value of all electrical undertakings which were subject to purchase by the local authority at the end of the term of the provisional orders, it was as well to point out that this company held an extremely satisfactory position as regarded the value of its assets. Last year he called the attention of the shareholders to the fact that they were gradually preparing to change over the whole district to the three-wire system so as to get the full benefit of the increased carrying capacity of the mains when the double pressure of 400 volts passed through the feeders. This work had continued, and a considerable portion of the district had been already changed over, and the number of users were still at the low pressure of 100 volts had been reduced approximately to one-half during the year. It was unnecessary for him to repeat his remarks of last year as to the changing nature of the district. So far the change that had taken place had apparently not prejudicially affected their output, so that, as last year, he might summarise his remarks by saying that the position of their undertaking was extremely good. The plant was in good order, a great portion of the old-fashioned plant had been written off; the plant they were now using was worked with increased economy, and the economical results and the good dividend that they paying, were chiefly due to the exertions of the staff of the company.

Mr. Roger Wallace, K.C., seconded the motion.

Mr. Killingworth Hedges congratulated the board on the balance-sheet, and said he was glad to see that there was no question of raising the price per unit to the consumer. Unfortunately he lived in the district of the Brompton and Kensington Co. who had increased their charges and had also charged for a minimum amount of current whether it was consumed or not. He thought that was a mistake. With regard also to street lighting, he hoped the company would not follow the example of the gas companies and enter into contracts which could not be remunerative. He thought if gas companies obtained contracts for street lighting at unremunerative prices they should be allowed to keep them.

The Chairman said that naturally they kept the question of street lighting before them, and watched very closely the efforts of the Gas Co. to oust electric lighting from the streets by quoting extremely low figures. Their own contract for street lighting did not expire till July of next year, but they supplied so little that it affected them very little. The question was somewhat complicated by the fact that they could quote very low prices for certain districts without loss to themselves, whereas there were other districts which would involve them in new capital expenditure if they had to give a supply. At the same time they were extremely good friends with the local authority.

The motion was carried, and the retiring directors were re-elected.

Westminster Electric Supply Corporation, Ltd.

Mr. Edmund Boulnois presided at the offices, Eccleston Place, S.W., on Wednesday last week over the annual meeting of the above corporation.

The Chairman said they would see in the directors' report a reference to an agreement with the London Electric Supply Corporation, which they had entered into with the approval of the Board of Trade with regard to the supply of electricity in their area. This was made under the London Electric Supply Act, 1908, which gave the supply companies in London power to enter into agreement for mutual assistance. In their area over 90 per cent. of the consumers were supplied by them and less than 10 per cent. by the London Co. This double system was very wasteful, for not only were there two sets of mains, two sets of stations, and two sets of officials to do the work which one set of each could do equally well, but a great deal of quite unnecessary capital expense had been caused by consumers changing from one company to the other as the whim of the moment or the interests of their contractors dictated. All this fighting between two electrical companies was simply playing into the hands of their common competitor, the gas company, and so they put their heads together and came to terms. Part of their premises at Eccleston Place were held on a short lease only, and in negotiating for the renewal of this the directors took the opportunity of acquiring further leases of surrounding property which would secure to the company room for all extensions in the way of buildings which were likely to be required in the future. The lease of the building where their main stores department was housed was also shortly falling in. This department was at present in some small and inconvenient premises at Bridge Place, some little way off, while the office work was necessarily done in the Eccleston Place building. They were therefore going to bring the stores here so that the whole department might be together, and better opportunities be given for economical working. Over these stores they were building flats for some of their engineers and workmen who had to be constantly available for emergencies, instead of renting premises for them, as hitherto, and they were taking the opportunity to rearrange the offices and add a good-sized showroom. For this and for the ordinary increase in business, further capital was required, and the cheapest way to raise it was by the issue of further preference shares. A large number of these shares had been taken up by the shareholders, and the directors had had further offers for the remainder. There was, however, no immediate need for the money, and they thought it better to issue the balance gradually as the money was required. If the present report were compared with that for 1909, it would be seen that there had been a falling off in the units sold of nearly 1½ millions, and, of course, a corresponding fall in receipts. This was due mainly to the increasing use of the metal lamps, and they estimated that about half the lamps in their area were now of this description. The increase of business was not yet sufficient to make up for this loss, and it was probable that there would be a further drop this year. They carried forward a considerable balance from 1908 and 1909 on purpose to meet the drop which they knew was coming, and they were taking from this balance £4,500 in order to pay the same dividend as last year, and they carried forward £15,000 to this year. Their new station at Horseferry was now at work and the old station at Millbank had been pulled down. He was sure the shareholders would wish to congratulate Sir Alexander Kennedy and his staff on having carried through the very difficult work of equipping the new station and changing over the supply to it from Millbank Street without a hitch of any kind. Not a single consumer had been inconvenienced for a single moment, and it would have been quite impossible for any of them to have told that such a change had been made. The new station was working very economically. In conclusion, he would like to tell the shareholders how well their fine undertaking was carried out by the staff and workmen. From the manager, Mr. Hordern, and the secretary, Mr. Iago, down to the most subordinate employé, the loyalty, zeal and efficiency were all that could be desired, and it was a great satisfaction to the directors that they were able to give this testimony. He moved the adoption of the report and accounts.

Mr. J. Browne-Martin, in seconding the motion, said that ultimately the metal-filament lamp must be a source of large profit to all electric lighting companies. When the companies were started, electric light was looked upon more or less as a luxury, but now it had become a necessity, and there was not the slightest doubt that the saving effected by these metal lamps would enable the poorest householder to burn electric light with much greater economy than he could at present burn gas, and this must ultimately put electricity into a much higher financial position than at present.

Mr. Hurst called attention to the various metallic-filament lamps on the market and the prices at which they were quoted, and pointed out that several of them, notwithstanding the variation in price, claimed to save 70 per cent. of current. He would like to know whether the directors could give any opinion on the merits of these lamps. Further, he asked whether it would not be possible for the company to acquire some metallic-filament lamps of its own. There were always new ideas on the market, and the company might pick up a lamp which they could sell to consumers at little over cost price, and so increase the use of electricity very largely.

Mr. A. Court asked whether the board had considered the question of a penny-in-the-slot supply. He would also like to know if there was any objection to setting out the investments in the accounts.

Mr. Reynell said that in the old days of carbon lamps they were beaten by the incandescent gas light, but now with the metallic-filament lamps it was the other way about. He asked whether they had canvassers going about explaining this to people. He suggested that they should employ canvassers at a small salary but a big commission.

The Chairman said the board were seriously considering the questions raised by Mr. Hurst, but at the moment it was not advisable to make any public statement with regard to it. They already had shilling-in-the-slot meters, and at the proper time they would consider whether it would be advisable to go beyond that. The board had always considered it inadvisable to publish a list of investments. They employed a staff of canvassers, who were paid by salary.

The report was adopted, and the retiring director re-elected.

Metropolitan Electric Supply Co., Ltd.

The directors, in their annual report, state that the capital expenditure has now reached a total of £1,939,530, being an increase during the year of £38,109. The gross revenue amounted to £172,737, being a decrease of £1,630. The working expenses amounted to £78,283, being a decrease of £1,565. The balance at the credit of the revenue account, before providing for depreciation, is £94,454. The directors have set aside £15,000 as an addition to the depreciation and reserve fund, carrying to the credit of the net revenue account £79,454. This sum, with the balance brought forward from last account, interest and dividends on investments, and other receipts, makes a total of £91,661. After deducting interest on debenture stocks and loans, dividend on preference shares and other charges, there remains a balance of £47,272. To this the directors have added £3,500 from the undistributed balance

of the Marylebone purchase money which was set aside towards the maintenance of dividends during the development of other business to replace the loss of Marylebone. This increases the balance at the credit of the net revenue account to £50,772. An interim dividend of 2s. per share (being at the rate of 4 per cent. per annum) on the ordinary share capital, amounting to £20,000, was paid on August 9th, and the directors recommend that a further dividend of 3s. per share (being at the rate of 6 per cent. per annum) on such shares be now paid, making a total distribution for the year of 5s. per share, or 5 per cent. This will absorb a further sum of £30,000 and leave a balance of £772 to be carried forward. The balance at the credit of the depreciation and reserve fund now amounts to £260,355. During the year, new connections representing the equivalent of 42,782 8-C.P. 30-watt lamps, equal to 1,283 KW., were added to the system, making a total connection at the end of the year of 890,484 lamps. Since April last there has been a steady increase in output and revenue. The stations, machinery and plant have been maintained in a satisfactory condition. The company has recently commenced a supply of electricity in Hanwell and Southall; an Act is being promoted in the present session of Parliament to legalise an agreement with the District Council of Acton for the purpose of acquiring their provisional order; and negotiations are in progress for supplies to authorised distributors in other portions of the company's bulk areas.

Para Electric Railways and Lighting Co., Ltd.

SIR WILLIAM EVANS-GORDON (chairman) took the chair on March 1st at the Cannon Street Hotel, E.C., over the sixth ordinary general meeting of this company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 304), the CHAIRMAN said the traffic revenue from the tramways rose from £156,859 in 1909 to £178,957 in 1910, an increase of 14 per cent. The number of passengers carried during the same period increased by practically the same percentage from 16,931,000 to 19,446,000. The operating expenses of the tramways during the same period increased from £80,370 to £95,495. This showed an increase of about £15,000 in the expenses as against an increase of over £22,000 in the receipts. The lighting receipts increased from £68,958 to £83,796—that was £14,838 or 21½ per cent. During the year arrangements were carried out to supply power to the Paraense Lighting Co., the shares of which had been purchased by their company, from the supply mains of the Para Electric. From this source they obtained 355 new consumers. In addition to these 355, they also connected 470 new consumers to the mains, making a total increase of 825 new consumers, or 41 per cent. during the year. The total connections based on the equivalent 16-C.P. incandescent lamps increased from 35,000 to 45,460, or 30 per cent. The chairman next referred to the item of "balance of exchange" in the profit and loss account, which he explained was due to the fact that the accounts of the company were kept on a fixed basis of exchange of 15d. to the Brazilian milreis, whereas, during the year, the exchange had been considerably higher. The Government had now fixed the rate at 16d., but for this year, to be on the safe side, the board would continue on the former basis of 15d. The total earnings of the undertaking in Para for the year were £136,880, or more than £30,000 above the corresponding figure for the preceding year. After payment of London expenses and interest on debenture stock, there remained a balance of £91,104, as against £60,590 last year. The preference dividend absorbed £17,700, leaving £73,404, or a total of about 19 per cent. on the ordinary share capital of the company. The directors had to consider what would be a reasonable sum to set aside for all reserves before fixing on the rate of dividend, and although the company had already had last year reserves amounting to £50,000, it seemed desirable to strengthen the position in every way and only pay a dividend at a rate which there would be every prospect of maintaining, and, if possible, increasing in the future. This was comparatively a new company, and they wished to see it on a strong financial basis with ample reserves, so that its ordinary shares might be a safe and reliable investment, bearing a dividend which they had every reason to believe would be maintained. With this policy in view the directors had only recommended a dividend at the rate of 6 per cent. for the last half-year, making 10 per cent. for the whole year, crediting £28,000 to the reserves of the company, and increasing the carry forward by £6,479. Not much more than one-half the available surplus was therefore distributed as dividend. The company spent during the year on capital account £31,021, which was over and above the sum of £24,373 from revenue, which was expended during the year on upkeep. The principal items of capital expenditure were the increase of rolling stock, and the extension of the lighting mains. It was obvious that, to take care of the large growth in the business of the company, additional capital expenditure was required for extensions, connections, meters, &c. The directors felt confident that this expansion in the lighting business would continue. The new rolling stock purchased during the year was only ready for service in October and November last, and, therefore, had only a very slight effect on the earnings of the year now under review. While the earnings and the number of passengers carried in the tramways department increased during the year by 15 per cent., the number of car-miles run was only 4 per cent. over those of the preceding year. Their friends there deserved a better service than they received during the greater part of last year, and the directors felt that a considerable amount of additional rolling stock was required to give an adequate service, and to maintain the growth of traffic receipts. The result of this policy during the last three months indicated that it was a wise one, as the number of passengers had been increasing at a greater rate than during last year. While for a few months it might mean an increased operating percentage, it also meant a total increased net earning, which would become greater as time went on. If the shareholders asked whether these heavy items of capital expenditure were likely to continue, they could only reply that they expected they would, and, in fact, hoped that they would, because they indicated a satisfactory growth of the company's business in Para. The power station load increased last year by 16 per cent., and with the new cars now being run, this rate of increase was continuing. Under the circumstances, to provide for the increase already realised, as well as for the probable growth during the next few years, the directors had already authorised the addition of two 600-KW. units in the power station. There would also during the current year be a further expenditure on extensions to the lighting lines and the taking on of new consumers. The increase in revenue would, however, they believed, more than justify this expenditure. It having been the policy of the company to set aside large sums for reserves, it had not been necessary up to the present to issue any additional capital to meet this heavy capital outlay. The directors believed that their own property, in the future of which they had every confidence, was the safest and best place for their reserves to be invested in. There were £95,000 par value of preference shares authorised and unissued available for securing funds for extensions and improvements. To be investing outside of the company's undertaking, or putting aside cash at the same time that the company was issuing additional capital for the development of their own property, would obviously be bad finance. In conclusion, the chairman dealt at some length with the conditions prevailing at Para as bearing on the future of the company. He thought that, owing to local conditions, they might expect the operating expenses of the tramway undertaking to be higher for the next few months, but he did not contemplate that it would average higher for the whole year, and therefore there should be a further growth of tramway net earnings in the current year. The development of the lighting business had only just commenced, and, amongst other things, they anticipated a considerable development in the sale of power for fans, &c., as the result of keeping the current on the lighting lines in the day time. Considering the situation as a whole, therefore, they had every reason to believe that the growth and the earnings of the Para Co. would further improve in the current and following years.

MR. E. C. CHESTON seconded the motion.

The report was adopted.

Charing Cross, West End and City Electricity Supply Co., Ltd.

THE annual general meeting was held on Thursday of last week at the offices, 6A, St. Martin's Lane, W.C., Mr. W. B. Fladgate presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 304), after referring with regret to the loss the company had sustained by the death of Mr. Brougham Glasier, who had been a director for 18 years, said that the first important matter to be noticed was that, whilst the increase of business had not been large, the effect of careful economy and of improved working had enabled them to increase more than rateably the profits of the company. In the West End the amount of revenue for the past two years was curiously the same—£142,431 in 1909 and £142,675 last year. When they looked at the other side of the account they were met with a much more satisfactory position, because while in 1909 the expenses were £79,252, last year they were only £72,687. That was a result which could not be considered as otherwise than satisfactory. Of course, in both cases they had to add the sum which they set aside for depreciation—*i.e.*, £11,000, with the net result that in 1909 their earnings were £52,179, while last year they amounted to £58,987, or an increase of no less than £6,808, which, he thought, they would agree was a very respectable increase. To the net earnings had to be added the carry forward, which in 1909 amounted to £5,162, and the interest earned in 1910, which amounted to £1,632, the result being that, after paying the debenture interest they carried to the net revenue account a balance of £47,454. Out of that they had to provide £18,000 for the dividend on the preference shares, and they had paid the interim dividend on the ordinary shares, which absorbed £10,000, leaving a balance of £19,953. Out of that they proposed to pay 5 per cent. on the ordinary shares for the whole year, which would absorb £10,000, and to carry forward £9,953, as against £5,162 brought into the account. In other words, they carried forward an extra £5,000, and they thought it wise to do that, rather than to suggest an increased dividend. It would be noticed that while the West End undertaking had generated slightly more units than last year, it had been able to do so with a decreased coal bill of £4,729, while in the City they had generated considerably more units, but it had cost them £689 more for fuel. They might be asked why they could not make as many economies in the City as in the West End. The answer was a very simple one. In the West End they had had to provide for the cessor of the lease of the Lambeth station, and had incurred a considerable amount of capital expenditure by setting up internal combustion engines for the purpose of replacing that supply. He told the shareholders that it was hoped that that would lead to economy, and the result had proved that their prognostications were in every way correct. The economy in the West End from their new plant was very considerable, but they did not think that it was a system which, at any rate for the present, they should entirely depend upon for their supply. It would be impossible for them to work the whole of their supply from their station at Bow, and the conditions there must remain the same as they had been from the

beginning. It was a very economical station, and when he was able to say that during last year they had generated nearly one million more units with an increased bill of only £689. he thought he might claim some credit for the engineer for the way in which the station had been worked. The capital expenditure during the past year had amounted to £33,000, the principal item being £19,000 for machinery which had been spent on installing the internal combustion engines to which he had referred. In addition, nearly £8,000 had been spent on mains, and £2,600 upon meters. The total reserves of the company at the end of last year amounted to £247,000, and it was well for them that they had those reserves, as he was afraid that next year, having regard to the fact of their giving up the Lambeth station, it would be necessary for him to ask them to deal with that money to a certain extent. Turning to the City undertaking, the gross earnings there had increased in a much better ratio than they did in the West End. In 1909 their takings amounted to £139,186; in 1910 they were £141,471, an increase of £2,200, while the expenses had been very nearly the same—£82,868 in 1909, and £82,741 last year. The net earnings were practically the same—in 1909 they amounted to £56,538, and in 1910 to £58,734; a net increase of £2,176. To those net earnings they had to add the carry forward from 1909 of £13,288, and after payment of interest on the debentures and loans, they brought forward a total of £41,576, out of which they had to use £18,000 for payment of the preference dividend, leaving £23,576 to be carried forward. They did not propose to deal with that amount in any way. The auditors had again called their attention to the fact that they had not allowed anything for depreciation in the City; and they did not propose, at any rate at present, to deal with that matter. They proposed to carry forward whatever they could without hypothecating it to depreciation or any other fund, and as long as they did not divide any of it as profits, it appeared to him that they were taking a wise course. The provisional order under which they worked in the City was drawn on very different lines to their West End order, and those of the other electric lighting companies. The general result over the whole area was that the sales were practically the same in 1909 as they were last year. The lamps connected were again practically the same—there was only an increase of 2·7 per cent. over the whole of the lamps connected. The increase in their sales in the West End to private customers was only 1·3 per cent.; while in the City the increase amounted to 5·3 per cent. There were good grounds for them not expecting any very large increase in their sales. There was a certain amount of saturation in the districts they served, which had been the case for many years past. Electric lighting had come, and had been appreciated; and the introduction of the metallic-filament lamp was also one reason why their sales had not increased more. On the contrary, it was as much as they could do to keep pace with the decreased consumption which had been brought about by the introduction of that lamp. Power and heating, which in days gone by they did not consider of much importance had helped them last year; for of the increase in the West End one-half was for those purposes, and in the City three-quarters of the increase was for power and heating, and only one quarter for lighting. The increase of those sales necessarily kept down the average price obtained for current. There was still competition going on with gas. They were now trying to get the public lighting of Holborn, and at present the matter was still open. If they succeeded he was sure they could give a good account of themselves and show that electricity for street lighting was a most excellent system to adopt. The lease of their Lambeth station ran out last year, and they had taken a temporary lease for this year, and in the early part of this summer that station would go entirely. They would be able to utilise a considerable amount of the plant at Bow and at their sub-stations. They would also be able to sell a certain amount, the proceeds of which would go to capital account, and the rest they would have to write off their reserves. They had improved the revenue by what they had already done in that direction, and they felt sure that the revenue would be further improved during the current year.

Mr. J. M. Gatti seconded the motion, and the report was adopted without discussion.

Mersey Railway Co.

The half-yearly meeting was held on March 2nd, at Worcester House, Walbrook, E.C.

The Chairman (Mr. J. Falconer, M.P.), in moving the adoption of the report (see Electrical Review, p. 311), said that the accounts showed a satisfactory record of continued progress as regarded the finances of the company. The net revenue for 1910 was £47,167 as compared with £41,330 in 1909, an increase of £5,837, or 14 per cent. In view of the fact that they were entering on a new period of five years granted by the debenture-holders, during which the payment of interest on certain of the debenture stocks would be contingent on the profits available each year; and in view, also, of the fact that the debenture-holders began to see a real prospect of getting payment of their interest, he had been asked by quite a number of debenture-holders to make a statement showing the position in which these stocks stood at the beginning of the year. As regarded the development of the company since electric traction was adopted, what it amounted to was as follows:—In the half-year ending December 31st, 1902, which was the last half-year of steam working, they carried 2,844,000 passengers, as against 7,411,000 passengers in the half-year ending December 31st, 1910—an increase of 120 per cent. The receipts during the last half-year of steam working were £29,470, compared with £55,419 for the half-year ending 1910—an increase of 88 per cent. The net revenue figures were even more striking, for while in the last half of 1902 it was £1,388, in the last half of 1910 it was £24,923. In other words, there had been an increase of £6,000 a year during the eight years. The loan capital consisted of five debenture stocks. The total debenture stock was £1,528,342, and the total interest payable upon it was £53,710 a year. Assuming that they did exactly the same in the current half-year as in the one he had been reviewing, the position would be as follows:—The net revenue for the year would be £49,846, against this, rent charges of £8,882, and £2,000 for the renewal fund, would have to be deducted, which would leave £38,964 available for the payment of interest. Out of this, £26,776 would go for the interest on the first perpetual debentures, and the balance would enable the interest on the 1866 stock and the 1871 stock to be paid in full, and leave £4,524 to be applied towards the payment of interest on the 1882-3-5 stock, which would be equal to 1¼ per cent. If their position continued to improve there would be so much more towards the payment of the interest on the 1882-3-5 stock, and when that was met then they would be in a position to pay something on the "B" stock. He had always refrained from anything in the nature of a forecast or speculation with regard to the future, and the only way in which he could properly assist debenture stock holders to judge of the position and value of their stock was to point to the way in which their net revenue had increased in the last eight years, and so far as they were able to judge there was absolutely nothing to suggest that the company would go back. With regard to the future, it depended upon the development of the district which undoubtedly showed signs of growing. The past half-year had not been even normally favourable for the development of their traffic because of the slackness of trade and a lock out in the engineering trade, so that a portion of their traffic did not yield what it normally would have done. The board, and he thought the shareholders, were obliged to the debenture-holders for the consideration they had shown, without which it would have been impossible for the company to have developed as it had done, and therefore it was a great satisfaction to the board to find themselves able to produce results which at any rate justified the confidence which the debenture-holders had shown in the company.

In reply to questions, the Chairman said the renewal fund stood at £14,000, and was now all invested in India stock. The principle they had gone on was to keep the rolling stock as good as new out of revenue. They were limited by their Act of Parliament from putting more than £3,000 a year to the renewals fund. This was for the protection of the debenture-holders.

Mr. T. Park, as an original shareholder of the company, and a Liverpool man, doubted whether the ordinary shareholders would get anything until the company was in the position to deal with goods traffic. He suggested that the board should consider the question of getting access to the docks railways, or of having a series of lifts for lifting their trucks similar to those at Seacombe Ferry.

Mr. Gardner Williams pointed out that all such developments needed capital, and the company could not raise it without credit. Apparently the board were doing their best to restore that credit by paying the debenture interest.

The Chairman said that the board were always considering the possibility of improving the traffics of the company.

The report was adopted.

W. T. Glover & Co., Ltd.

The directors' report for the year ending December 31st, 1910, states that the result of the trading is a credit balance of £25,707, plus £11,554 brought forward, making £37,261. There have to be deducted: Directors' remuneration, voted March, 1910, £1,000; directors' expenses during 1910, £73; interest (at 4½ per cent.) on first mortgage debenture stock, £4,250; interest (at 5 per cent.) on second mortgage debenture stock, £3,800; also the appropriation for payment to trustees of second mortgage debenture stock, £4,000. It is proposed to deal as follows with the balance of £24,137:—Dividend on 5 per cent. cumulative preference shares (£100,000) to December 31st, 1910, less income-tax, £4,708; transfer to first mortgage debenture redemption fund, £2,500; dividend on ordinary shares (£114,850) at the rate of 5 per cent., less income-tax, £5,408; transfer to reserve fund, £6,000; leaving to be carried forward, £5,521. The directors recommend the payment of the dividend on the 5 per cent. cumulative preference shares for the year ending December 31st, 1910, and also the payment of a dividend on the ordinary shares at the rate of 5 per cent. for the same period. Mr. A. E. Tanner, who for many years has been (and who continues to be) employed on the technical staff of the company, was in December last appointed a director. Mr. Henry Edmunds has resigned his position on the board.

The dividend for the year 1909 was at the same rate. Last year there was no transfer to reserve fund but the carry forward was as stated, £11,554.

Western Telegraph Co., Ltd.—The directors have declared the second quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1911, being at the rate of 6 per cent. per annum.

Bank Rate.—The Bank Rate was yesterday reduced from 3½ to 3 per cent.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Mar. 1	2,568	+ 147	39	55,053	+ 1,462	..	..
Ayr	„ 4	376	+ 11	42	12,577	+ 455	8	..
Bath	„ 1	1,292	+ 12	9	5,767	— 103	..	..
Belfast	„ 3	8,385	+ 947	48	197,674	+18,790	37	..
Birkenhead	„ 5	2,152	+ 69	48	52,936	+ 1,041	13·68	..
Birmingham Corp.	Feb. 25	18,928	+ 404	47	92,334	+ 8,567	56·5	..
Blackburn	Mar 1	1,922	+ 71	48½	51,204	— 839	14·12	..
Blackpool Corp.	„ 2	9 8	+ 132	..	54,654	+ 840	..	..
Blackpool-Fleetw'd	„ 4	525	+ 4	9	2,187	+ 162	..	..
Bolton	„ 5	4,648	+ 187	19	115,322	+ 2,765	26	..
Bournemouth	„ 1	2,687	— 73	47½	83,517	+ 4,900	21·95	..
Bradford	Feb. 25	9,694	+ 870	47	240,945	+11,264	54·81	..
Brighton	Mar. 5	1,529	— 19	48½	46,308	+ 357	9·5	..
Bristol	„ 3	11,136	+ 703	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Feb. 21	4·0	— 16	8	1,662	— 4	3·65	..
Barnsley	„ 21	319	— 9	„	1,298	+ 19	..	..
Barrow	„ 24	4·0	+ 28	„	1,748	+ 39	5·37	..
Cavehill	„ 24	119	- 18	„	457	+ 64	..	..
Devonport	„ 24	822	+ 80	„	3,236	+ 157	8·85	..
Gateshead	„ 24	1,994	+ 89	„	7,722	+ 439	11·25	..
Gravesend	„ 24	352	— 13	„	1,353	— 40	6·5	..
Greenock	„ 24	1,200	+ 198	„	4,542	+ 808	7·25	..
Hartlepool	„ 24	434	+ 44	„	1,623	+ 83	6·72	..
Kidderminster	„ 24	168	+ 8	„	638	+ 14	..	..
‡Leamington	„ 24	260	— 18	„	992	— 66	..	..
Merthyr	„ 24	384	+ 17	„	1,400	— 10	2·9	..
Metropolitan	„ 24	15,230	+2,440	„	58,087	+ 9,020	22	..
Middleton	„ 24	5 6	+ 84	„	2,15·	+ 232	8·5	..
Mid. Joint Com'tee	„ 24	11,391	+ 410	„	43,617	+ 159	..	..
Oldham—Ashton	„ 24	1,028	+ 91	„	3,975	+ 178	9·18	..
Peterborough	„ 24	199	+ 10	„	750	+ 51	5·31	..
Potteries	„ 24	3,783	+ 869	„	14,36·	+ 1,297	29	..
Rothesay	„ 24	80	+ 7	„	831	+ 14	2·75	..
Southport	„ 24	465	- 13	„	1,740	+ 93	8·17	..
S. Metropolitan	„ 24	1,359	+ 23	„	5,243	— 24	..	..
Swansea	„ 24	2,049	+ 174	„	8,002	+ 486	12·5	..
Tynemouth	„ 24	289	+ 26	„	1,180	+ 74	3·75	..
Weston-s-Mare	„ 24	33	+ 10	„	128	— 06	3	..
‡Worcester	„ 24	455	..	„	1,759	— 20	5·75	..
Wrexham	„ 24	170	+ 5	„	667	+ 21	..	..
Yorks. Wool. Dist.	„ 24	1,9·2	+ 49	„	7,727	+ 760	17	..
Miscellaneous	„ 24	382	+ 9	„	1,·78	+ 61	..	..
Burnley	Mar. 4	2,410	+ 102	..	..	..	11·73	1
Burton-on-Trent	„ 5	619	+ 24	48	13,097	+ 297	6·42	..
Bury	„ 5	2,252	+ 53	48½	56,530	+ 1,117	22·5	..
Cardiff	„ 4	4,354	+ 310	49	105,749	+ 2,2·8	..	..
Carlisle	..	..	..	..	..	..	..	..
Chatham and Dist.	„ 2	1,548	+ 46	9	6,564	— 49	14·98	..
Cork	„ 2	895	+ 70	9	3,654	— 10·	9·69	..
Croydon	..	..	..	..	..	..	..	..
†Darlington	Feb. 25	208	+ 28	48	9,605	+ 801	..	..
Darwen	Mar. 3	474	+ 36	48	11,444	— 375	4·36	..
Dover	Feb. 25	332	+ 10	47	10,219	+ 507	4·75	..
Dublin	Mar. 3	10,1·0	+ 557	..	44,429	+ 778	54·25	..
Dundee	„ 1	2,·84	+ 50	41½	49,467	+ 557	15	..
East Ham	„ 4	1,973	+ 34	48½	49,894	+ 2,079	7·87	..
Exeter	„ 3	520	- 3	45	15,108	— 648	5·5	..
Glasgow	„ 4	36,147	+2,028	..	703,345	+41,503	97·75	3·25
Hastings	„ 2	1,395	— 59	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
Hull	„ 4	5,546	+ 164	48	133,778	+ 6,468	14·5	..
Ilkeston	„ 2	249	+ 5	48	6,119	— 231	..	..
Ipswich	„ 4	678	+ 14	48	19,8·9	+ 1,014	10·5	..
Kilmarnock	„ 4	282	— 8	42	6,372	+ 264	4·25	..
Lancashire United	„ 1	2,411	+ 47	..	10,350	+ 203	39	..
Leeds	„ 4	15,882	+ 714	48	389,758	+12,903	57	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 4	1,108	+ 84	41½	24,951	+ 131	8·72	..
Liverpool	Feb. 25	21,560	+ 813	8	85,864	+ 2,282	116	6·5
‖L.C.C.	„ 12	80,467	+8,848	..	1,955,922	+198,995	182·2	2·75
London United	Mar. 4	10,880	+ 66	..	47,015	— 144	..	..
Lowestoft	„ 4	570	+ 5	22	3,526	+ 175	..	..
Manchester	„ 4	30,47·	+1,264	48	744,213	+24,685	183	..
Newcastle	„ 4	8,014	+ 610	..	194,137	+ 3,511	14·5	..
Newport	Feb. 25	1,490	+ 71	48	32,075	+ 1,18·	14·5	..
Oldham	Mar. 5	3,648	+ 846	49	10,359	+ 2,679	28·5	·5
Pontypridd	..	..	..	..	..	..	..	..
Portsmouth	Feb. 25	3,185	— 17	47	94,948	+ 1,523	15·25	..
Preston	Mar. 1	1,412	+ 68	43	31,9·7	— 1 8	..	..
Rotherham	..	..	..	..	..	..	..	..
Salford	„ 6	9,079	+ 229	48½	226,073	+ 6,009	..	..
Sheffield	„ 7	12,402	+ 926	49	299,069	+19,122	40	..
Southampton	„ 1	1,965	+ 59	48	52,3 3	+ 1,470	..	..
Southend-on-Sea	„ 2	774	+ 29	48	27,077	+ 2,762	..	..
South Shields	„ 4	1,078	+ 79	48½	26,9·9	+ 11·	..	..
Swindon	„ 1	258	— 9	..	6,·32	+ 301	..	..
Tyneside	„ 1	817	+ 113	9	3,291	+ 260	..	..
Wallasey	„ 4	1,904	+ 332	49·	46,162	+ 2,547	..	..
Walthamstow	„ 4	1,254	+ 83	48	33,557	+ 2,263	9	..
West Ham	Feb. 23	4,711	+ 209	47	116,453	+ 5,998	15·25	..
Wolverhampton	Mar. 1	1,888	+ 164	48	45,156	+ 4,276	14·25	..
Cen. London Rly.	„ 4	10,546	— 707	9	48,614	— 1,558	6·32	..
City & S. Lon. Rly.	„ 5	6,824	+ 16	9	31,310	+ 1,063	7·26	..
Dublin-Lucan Rly.	„ 3	218	+ 8	9	924	+ 22	7	..
G.N. and City Rly.	„ 4	3,150	+ 94	9	14,301	+ 434	3·5	..
L'pool Overh'd Rly.	„ 5	2,785	+ 190	..	12,858	+ 864	6·8	4·3
Llandudno-Col. Bay	„ 3	265	+ 16	13½	1,59·	+ 89	..	..
London Elec. Ry. Co.	„ 4	27,960	+ 7·0	9	127,740	+ 6,945	21·5	..
Mersey Railway	„ 4	3,981	+ 68	9	18,179	+ 427	4·5	..
Metropolitan Rly.	„ 5	33,273	+ 807	..	154,554	+ 4,166	24·5	..
Met. District Rly.	„ 4	28,530	+1,173	9	106,058	+ 7,985	24	..
Anglo-Argentine	„ 4	99,829	+13,937	..	441,184	+58,374	..	..
‖Auckland	Feb.	16,576	+1,674	..	126,274	+13,411	28·81	·6
Bombay (B.E.T.)	„ 8	5,721	+ 457	5	14,061	+ 667	..	..
Brisbane	Feb.	17,675	+1,925	8	86,835	+ 3,995	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Mar. 4	7,620	+ 230	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
‖Kalgoorlie, W.A.	Jan.	3,244	..	..	..	..	20·5	..
‖Lisbon	Dec.	1,699	+ 120	..	33,020	+ 1,510	..	..
Madras	Feb. 23	1,161	+ 80	..	5,825	+ 470	..	..
‖ Montevideo	Feb.	29 792	+3 967	32	112,497	+10,577	..	..
†Perth (W.A.)	Mar. 3	3,283	+ 146	..	14,864	+ 647	99	1

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. One month.

STOCKS AND SHARES.

Tuesday Evening.

Sustained strength in Consols is always a good thing for other investment departments, and the firmness of the Funds has done much for prior-charge securities of all descriptions. This is plainly noticeable in such issues as Telegraph Debentures, which this week show a number of comparatively small rises. The difficulty nowadays is to get hold of really good stock except where a free market exists, because most sound securities are so well held that frequently the only chance of obtaining them is through the realisation of a deceased estate. Even then it may happen that for some particular stock there is a "waiting list" of buyers, and the man at the top of it is allowed as a sort of favour to have the security, while the others go on waiting.

The County of London Electric Lighting Company has issued an excellent dividend statement, which fully justifies the recent rise in the shares, the price of which remains firm at 8½. With this came good City of London figures, which had a hardening effect upon the quotation for the Ordinary shares. The Metropolitan Electric Supply results show a decrease in gross revenue of £1,630, offset by a lesser expenditure of £1,564, with a dividend of 3s. per share, making 5 per cent. for the year, to which proprietors have lately been accustomed. A small gain in the Preference is the only change in the company's shares.

Charing Cross City Undertaking Preference have risen ¼, which removes some of the disparity between these and the company's other 4½ per cent. Preference shares. South Metropolitan Preference are another 7½d. better, and Chelseas rose ⅛. Kensington Ordinary and Notting Hill are 5s. to the good. Stock Exchange brokers are directing the attention of their investment clients to the electric lighting group of shares, and the section is certainly beginning to expand in popular favour. Edmundson's Ordinary put on 2s. 6d., but the Preference made no further contribution to their advance of last week. The talk of amalgamation in this market has helped the prices of the companies concerned.

If a merely lay and financial opinion may be permitted on a purely trade point, it might take the form of a hope that the coming Coronation festivities should be well and promptly considered by the electric lighting companies, as for such an occasion early organisation of forces is sometimes more than half the battle Edison & Swan "A" shares and the company's two Debenture stocks stand out with good rises this week, other manufacturing issues being quiet. Brush First and Second Debenture stocks are 4 and 3 points higher respectively. British Electric Tractions have been called to something like a halt, the Preference are down ½, and the Second Debenture stock parted with its 2 points gain of last week. London United Trams have also gone back slightly after their substantial rise, and there are small declines in Metropolitan Tramways Preference and Deferred shares. The latter must, of course, be regarded as a gambling counter, but the 5 per cent. Preference shares at about 17s. 6d. look a reasonably good investment purchase.

Calcutta Trams have improved, and British Columbia Electric Railway issues eased off. There has been a little inquiry for Cape Trams again, after a few weeks quietude, and the price is talked better by people who profess to know what may be likely to happen. It is getting on for six years since the shares last received any dividend.

In the Home Railway division, the steam stocks display a good deal of quiet strength, Brighton Deferred being particularly favoured. Metropolitan Consolidated slipped back a trifle, but it had so good a rise last week that this was only to be anticipated. Attention is directed in several ways to the Company's Surplus Lands stock, the attraction being the manner in which the lands have increased in value of late years, and the price has gained a point to 67, at which the actual return is about 4½ per cent. on the money. East Londons have fallen back to 5, after being 6¼, and the Debenture stocks are inclined to be easier. City and South London shows little resisting power to the least pressure to sell, and the price shed ½, while in Central Londons there is no change to report.

Reference has been made above to the gains of ½ per cent. which various telegraph Debenture stocks have added to their prices. Beyond this, there is not much to say about the market. A rush to take profits in advance of the settlement was responsible for an abrupt reaction in West India and Panama Ordinary, but the Preferences have been bought, and the Debenture stock rose ½ with others of its class. Amazon shares have been good, and Anglo-American Deferred, after rattling up at a great pace to 27⅝, went back ½, which left the stock ⅛ to the good on balance. Eastern Ordinary rose 1.

National Telephone Deferred went back ½, and the third Preference shares lost ½, speculation having been very heavy in both during the past few weeks. Both Debenture stocks, however, are ½ higher, being bought by those to whom a short-date security is always tempting when it is gilt-edged. The 4 per cent. stock, supposing it to be bought at 100 now, for payment on March 24th, will receive 2 per cent. on June 30th, and 2 per cent. on December 31st, that is, £4 in nine months, equal to £5 6s. 8d. per cent. per annum, with perfect safety. Allowing for income-tax, the yield is a few pence above the level 5 per cent., which is not bad for a stock where there is no risk to be run.

Rio Trams at 109 are again somewhat easier, while Mexico Trams remain firm. Mexican Light and Power issues are steady, and this section, generally speaking, is quiet. A big new power company, the Mexican Northern, is in active course of preparation, but the prospectus may not appear until the early part of April.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Feb. 28th.	Closing Quotations March 7th.	Business done week ended March 7th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
800,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅝ — 6¼	5⅞ — 6⅜	..	..	+ ⅛	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	97⅛	..	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	148 —150	147 —149	..	..	—1	5 7 5
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	£4¼	..	..	4 4 3
545,920	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅝%	3⅝%	68 — 70	68½ — 70½	69⅛	68½	+ ½	5 6 5
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	111½—112½	111½—112½	112⅜	111½	..	5 6 8
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	26⅛ — 27⅛	27 — 27½	27⅛	26 1/16	+ ⅛	5 10 1
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 1/16 — 7 3/16	7 1/16 — 7 3/16	..	..	..	5 9 5
2,462,809	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	86 — 88	86½ — 88½	87⅜	86¾	+ ⅛	4 10 5
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9 — 9¼	9 — 9¼	..	..	..	6 3 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17 — 18	17 — 18	17⅛	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅞ — 4	3⅞ — 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8½ — 9	8½ — 9	8⅝	8⅜	..	5 11 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+ ½	4 8 8
60,710‡	Direct United States Cable	10	4½%	4½%	4 %	5 %	7⅞ — 8	7⅞ — 8	7 13/16	7⅞	..	6 4 8
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99½—101½	..	..	+ ½	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	134 —137	135 —138	136⅜	136	..	5 2 2
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83½ — 85½	83½ — 85½	84½	84½	— ½	4 1 10
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	101 —103	101½—103½	102	..	+ ½	3 17 4
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜ — 13⅝	13⅜ — 13⅝	13⅜	13½	..	5 2 9
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	99½—101½	99½—101½	100⅛	100	..	3 18 10
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100½—102½	100⅜—102½	..	..	..	3 18 1
181,127	Globe Telegraph and Trust	10	5⅞%	5⅝%	5⅞%	..	10⅝ — 11	10⅝ — 11	10 13/16	10 9/16	..	5 4 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13 — 13½	13 — 13½	13⅜	13 1/16	..	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	18 %	18 %	..	32½ — 33½	32½ — 33½	..	..	..	5 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	56½ — 58½	56½ — 58½	58	..	..	5 11 1
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	94 — 97	94 — 97	..	..	..	4 7 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	13/16 — 15/16	13/16 — 15/16	17/8	16/6	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	31/32 — 1	31/32 — 1 1/32	..	..	+ 1/32	5 17 1
66,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	29/32 — 31/32	29/32 — 31/32	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104 —105 xd	104 —105	105	104	..	5 14 3
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	138 —140 xd	138 —140	139⅛	136	..	4 5 9
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜ xd	10 — 10⅜	..	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 11 xd	10½ — 11	10 13/16	10⅜	..	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	6 — 6⅛ xd	5⅞ — 6⅛	6 1/16	6 1/32	— ⅛	4 1 8
2,300,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98½—100⅝	98⅝	98¼	+ ⅛	3 9 8
1,988,593	Do. do. 4 % Deb. Stock Red.. ..	100	4 %	4 %	4 %	4 %	98½—100½	99 —101	..	..	+ ⅛	3 19 3
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1⅜ — 1⅝	1⅜ — 1⅝	32/9	..	..	4 11 5
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87 — 89	87⅛	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	98 —100	98½—100½	..	..	+ ⅛	3 19 7
11,839	Reuter's	8	5 %	5 %	5 %	..	7⅞ — 8	7⅞ — 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96½ — 98½	96½ — 98½	..	..	..	4 11 5
2,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	133 —136	133 —136	..	..	..	4 8 3
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7⅜ — 7⅝	7 1/16 — 7 3/16	7⅜	7⅛	..	5 1 7
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..	4 7 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1¼ — 1⅜	1¼ — 1⅜	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97½ — 99½	98 — 100	..	..	+ ½	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅝ — 14⅛	13⅝ — 14⅛	13⅞	13⅜	..	4 9 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2⅛ — 2⅜	2⅛ — 2⅜	46/3	38/9	— ⅜	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅛	10 — 10⅛	10 7/16	10⅛	..	5 14 3
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14⅓%	..	8⅝ — 9⅜	9 — 9⅜	9 7/16	..	+ ⅛	6 6 4
80,000‡	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	101 —103	101½—103½	101⅛	..	+ ½	4 16 7

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	..	4⅛ — 5⅛	4⅛ — 5⅛	5 3/32	99/4½	..	4 17 7
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	..	4⅜ — 4⅞	4⅜ — 4⅞	96/8	93/9	..	5 2 7
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	92 — 93½	92 — 93½	92⅜	92	..	4 5 7
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —106	104⅞—106⅞	105⅞	..	+ ⅛	4 18 11
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	24 %	..	5⅞ — 6⅛	5⅝ — 5⅞	5 13/16	5⅝	— ⅛	4 2 1
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅛ — 1⅜	1⅜ — 1⅝	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock	100	8 %	8 %	8 %	..	146 —149	145½—148½	147⅛	..	..	5 7 5
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	125½—128½	125 —128	126⅛	126¼	— ⅛	4 18 9
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	109 —112	109 —112	110⅛	..	..	4 9 8
230,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	103⅛	..	..	4 6 7
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1⅞ — 2⅛	1⅞ — 2⅛	40/7⅛	35/-	—1/16	Nil
161,437	Do. do. 6 % Cum. Pref.	10	8 %	1½%	Nil	..	4 1/16 — 5 1/16	4 1/16 — 4 1/8	100/-	93/9	..	Nil
1,473,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	95 — 99	95 — 99	97½	97	..	5 1 0
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	77 — 82	75 — 80	76	..	..	5 9 9
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	7 — 7⅜	7 — 7⅜	..	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅜ — 6⅛	5⅜ — 6⅛	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.. ..	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	96 — 99 xd	96 — 99	..	..	..	4 10 11
500,000	British Westinghouse 10 % Pref., 1 to 200,000 and 275,001 to 575,000 Non-cum.	5	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	9/3	..	..	Nil
1,241,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	61	60	..	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,888	Brush Electrical Engineering, Ord., 1 to 140,838 ..	2	Nil	Nil	Nil	..	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
199,885	Do. do. Non-cum. 7 % Pref.	2	Nil	Nil	Nil	..	29/32 — 31/32	29/32 — 31/32	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	50 — 55	54 — 59	58	52½	+4	7 12 6
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	35 — 40	38 — 43	..	..	+3	10 9 4
137,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	..	5⅛ — 5⅝	5⅜ — 5⅞	5 5/16	5⅛	+ ⅛	3 16 7
47,295	Do. 5 % Cum. Pref., 1 to 47,295 ..	5	5 %	5 %	5 %	5 %	4¼ — 5⅛	4⅜ — 5⅛	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 — 100	..	..	..	4 10 0
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛ — 9⅜	9⅛ — 9⅜	..	..	..	5 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4⅜ — 5	4⅜ — 5	99/4½	98/9	..	4 18 0
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	11/8	10/-	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 1/16 — 3 3/16	3 1/16 — 3 3/16	65/-	63/9	..	5 6 1
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	103 —106	103 —106	104	..	..	4 4 11
1,864,720	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	68 — 70	66 — 68	68½	67	—2	4 8 3
572,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	84 — 86	84½	..	..	4 13 0
572,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	49 — 51	49 — 51	50	49	..	3 18 5
1,480,000	City and South London Railway	Stock	2½%	1½%	1½%	1½%	29½ — 30½	29 — 30	30	29½	..	4 18 4
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil.
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 1,100 of £50 Red	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Feb. 28th.	Closing Quotations March 7th.	Business done week ended Mar. 7th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	1 1/16 — 1 1/16	1 — 1	18/3	.	+ 1/16	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/8	1 — 1 1/8	..	..	..	5 6 8
265,430	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12 1/2 — 13 1/2	12 1/2 — 13 1/2	..	..	..	4 10 7
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	12/6	10/6	..	Nil
17,189	Do. "A" shares, 01—017,189	5	2½%	Nil	Nil	..	1 1/2 — 2 1/2	1 1/8 — 2	..	..	+ 1/8	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 67	65 — 69	67	..	+2	5 15 11
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	78 — 81	80 — 83	..	..	+2	6 0 6
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	1/2 — 1	1/2 — 1	16/8	16/-	..	Nil
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	7 %	7 %	7 %	..	1 1/16 — 2 1/16	1 1/16 — 2 1/16	40/-	..	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8 1/2	8 — 8 1/2	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	85 — 90	85 — 90	..	..	..	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	½%	Nil	Nil	..	1/2 — 1	1/2 — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10 1/2 — 10 3/4	10 1/2 — 10 3/4	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	103 —103 1/2	102 —103 1/2	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12 1/2 — 13	12 1/2 — 13	..	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4 1/8 — 5 1/8 xd	4 1/8 — 5 1/8	..	..	..	4 7 10
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	107½	..	..	4 5 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15 1/2 — 16 1/2	15 1/2 — 16 1/2	..	..	..	6 1 8
87,500	†Liverpool Overhead Railway, Ord.	10	½%	Nil	Nil	1½%	2 1/16 — 2 1/8	2 1/16 — 2 1/8	..	..	..	5 9 1
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7 1/2 — 7 3/4	7 1/2 — 7 3/4	..	..	..	6 9 0
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	Nil	1 1/2 — 2 1/8	1 1/8 — 2 1/8	..	..	..	Nil
399,980	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	Nil	1 1/2 — 2 1/8	1 1/8 — 2 1/8	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3¾%	Nil	Nil	3 — 3 1/2	2 1/8 — 3 1/8	63/9	57/6	— 1/8	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	74 — 78	73 — 77	73½	..	—1	5 3 11
5,782,062	Metropolitan Consolidated	100	½%	½%	1 %	1½%	45 1/2 — 46 1/2	45 1/2 — 46	46½	45⅞	— ⅛	2 9 3
2,640,914	Do. Surplus Lands	100	2¾%	2¾%	2¾%	2¾%	65 — 67	66 — 68	67⅛	65⅝	+1	4 0 11
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26 1/2 — 27 1/2	26 1/2 — 27	27½	26½	— ½	Nil
891,337	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	..	1 1/16 — 1 1/16	1 1/16 — 1 1/16	19/-	..	..	4 14 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1/4 — 3/8	1/4 — 3/8	..	..	— 1/16	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/4 — 7/8	3/4 — 7/8	18/-	17/3	— 1/16	5 9 7
589,188	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	101 —103	101 —103	102½	102	..	4 7 5
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	128 —129	128 —129	129	128½	..	4 13 0
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	100 —101	97½ — 98½ xd	98⅜	97⅜	..	5 1 6
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	1/32 — 3/32	1/32 — 3/32	7/-	6/-	— 1/16	4 6 7
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/32 — 5/32	3/32 — 5/32	13/6	13/3	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	81 — 84	..	..	+1	5 7 2
87,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	20 %	39 — 41	39 — 41	40	..	..	5 17 8
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1919	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100½	..	..	3 18 5
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	101½—102½	102 —103	102½	102	+ ⅛	4 17 1
2,818,700	Do. do. 4½ % Bonds	..	..	4½%	4½%	..	97 — 99	97 — 99	98⅛	97⅝	..	4 10 11
4,928,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	46 — 48	46 — 48	47⅛	46¼	..	2 1 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	1/32 — 3/32	1/32 — 3/32	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	8 %	..	1 — 1½	1 — 1½	..	..	..	10 0 0
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 8 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 30,449	5	10 %	10 %	10 %	..	7 3/8 — 7 7/8	7 3/8 — 7 7/8	..	..	..	6 7 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7 7/8 — 7 7/8	7 7/8 — 7 7/8	..	..	..	4 18 11
402,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	4 1/2 — 4 3/4	4 1/2 — 4 3/4	87/6	..	..	5 15 9
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4 3/8 — 4 5/8	4 3/8 — 4 5/8	87/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	4 3/8 — 4 5/8	4 3/8 — 4 5/8	81/3	..	+ 1/8	5 2 10
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
49,436	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	5 %	4 1/4 — 4 5/8	4 1/4 — 4 5/8	..	..	+ 1/8	5 5 8
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	7 %	11 3/4 — 12 1/4	11 3/4 — 12 3/8	12 1/4	12 1/16	+ 1/8	5 13 2
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12½	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	119 —123	119 —123	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101½	..	..	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1 1/4 — 2	1 1/4 — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2 3/8 — 3 1/8	2 3/8 — 3 1/8	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 6
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..	..	5 19 5
55,000	Do. do. 6 % Pref., 40,001—80,000 and 120,001—135,000	10	6 %	6 %	6 %	6 %	10 1/2 — 11 1/2	10 1/2 — 11 3/8	11 1/4	11 1/8	+ 1/8	5 5 6
450,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —109	106 —109	106⅛	..	..	4 2 7
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	101¼	101	..	4 8 8
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	3/8 — 3/32	1/4 — 3/32	12/6	10/-	+ 1/8	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1 1/2 — 2 3/8	1 1/2 — 2 3/8	45/-	48/9	+ 1/2	Nil
480,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	81 — 85	82 — 85	83¼	83	..	5 5 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	83½ — 85½	81 — 83 xd	82	..	..	5 17 0
10,000	Folkestone, 1 to 10,000	5	5¼%	5¼%	5¼%	..	4 3/8 — 4 5/8	4 1/2 — 4 3/4	..	..	+ 1/8	5 15 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4 3/8 — 5 1/8	4 3/8 — 5 1/8	..	..	..	4 11 11
94,350	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8¼%	8¼%	8¼%	9 %	6 3/8 — 7 1/8	6 3/8 — 7 1/8	6 3/8	6 1/16	..	5 19 4
$1,526,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	101 —103	102 —104	102⅜	..	+1	4 16 2
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	9 %	7 — 7 1/2	7 1/2 — 7 3/4	..	..	+ 1/4	5 16 2
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½%	3 %	2 %	2 %	1 1/16 — 1 1/8 xd	1 1/16 — 1 1/8	..	..	..	3 3 6
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 1/2 — 5 1/2 xd	4 1/2 — 5 1/2	5	97/6	..	5 17 1
387,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4 %	4 %	4 %	90 — 93	91 — 94	92½	92	+1	4 5 1
200,000	Metropolitan Electric Supply, 100,001 to 300,000	5	6¼%	5 %	5 %	5 %	4 1/4 — 4 3/8	4 1/4 — 4 3/8	90/-	88/9	..	5 5 3
76,121	Do. 4½ % Cum. Pref. 1—76,121	5	4½%	4½%	4½%	4½%	4 1/16 — 4 1/8	4 3/8 — 4 5/8	87/6	..	+ 1/16	4 17 4
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83 — 86	84 — 87	83½	..	+1	4 0 6
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	90½ — 91½	90½ — 91½	92½	90⅝	..	5 9 3
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3½%	4 %	..	92½ — 93½	91 — 93	92½	92	—1	4 6 0
$5,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	112 —113	112 —113	113¼	112¼	..	6 3 11
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	96½ — 97½	96½ — 97½	98	96⅞	..	5 2 7
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96½ — 97½	97 — 99	..	..	+1	4 10 11
130,491	Newcastle-on-Tyne, 1 to 50,000 & 57,010 to 137,500	5	8 %	2½%	4 %	..	3 3/4 — 4 1/4	4 1/4 — 4 3/8	..	..	+ 1/8	4 6 6
137,500	Do. 5% Pref., 1 to 137,500 Non. Cum.	5	5 %	5 %	5 %	..	4 3/8 — 5 1/8	4 3/8 — 5 1/8	..	..	+ 1/8	4 15 3
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97⅛ — 99⅛	97⅛ — 99⅛	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	7½%	8 %	12 — 12 3/4	12 1/4 — 13	12 1/16	12⅛	+ 1/8	6 3 1
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 1/4 — 6 3/4	6 1/4 — 6 3/4	..	..	..	5 3 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	225—235	225 —235	..	..	..	3 16 6
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103—113	103 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	8 1/4 — 8 3/4 xd	8 3/8 — 8 5/8	8 1/2	..	+ 1/8	5 12 8
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 1/2 — 7 1/4 xd	6 1/2 — 7 1/4	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1 1/2 — 2	1 1/2 — 2	..	..	..	..
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	3 — 3 3/8	3 — 3 3/8	..	..	..	5 19 5
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	103	..	..	4 16 3
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	Nil	Nil	3/32 — 5/32	3/32 — 5/32	..	..	..	Nil
142,988	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/32 — 1 3/32	1 — 1 1/32	..	..	+ 1/32	6 11 9
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	3/4 — 7/8	3/4 — 7/8	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1 3/4 — 2 1/8	1 3/4 — 2 1/8	42/6	..	..	10 10 6
371,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 84	82 — 84	..	..	..	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	7/8 — 1 1/8	7/8 — 1	..	..	+ 1/32	5 0 0
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	8 1/4 — 8 3/4	8 3/8 — 8 5/8	8 1/2	8 1/4	..	6 3 1
81,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5 1/8	5 — 5 1/8	5	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3½ per cent. February 16th, 1911.

WORKS COSTS.

By CHARLES C. GARRARD, M.I.E.E.

(*Concluded from page* 327.)

Another advantage of having the prices of standard work ready filed on operation schedules, is that it enables that very desirable state of organisation to be reached in which all work, for which instructions have been issued to the works, has been priced as regards labour. As the job tickets will also indicate the department where the work is to be carried out, it is a comparatively simple matter to construct daily curves showing the amount of piecework there is to be given out in each shop. As regards piecework tickets which have been issued, these wonld be generally, but not necessarily, only issued from the office when the material required for the job represented by the tickets is ready. Directly, however, the material is ready, it is sent along with the piecework ticket into the assembly room belonging to the shop where the work is to be done, there to take its turn on the bench or machine. If now a similar daily curve is kept of the amount of piecework tickets waiting in the assembly room, this, in conjunction with the curve in the piecework office, gives an exact and quantitative measure of the work in hand, and is of very material assistance in settling upon times of delivery of new orders.

Assembly Room.—Mention has just been made of the assembly room. This is a very important feature. This room is not of the nature of a sub-stores, as it only contains material which has been assembled in trays ready for particular jobs. This room should be under the control of the shop foreman, and if properly organised will be of great assistance to him. He will in effect be able to see what work is ahead of him, go over the different jobs, arranging to give them to the various men who he knows will in the near future finish the work they are engaged upon. In fact, it will enable him to exercise that forethought and contrivance which constitute the chief function of the foreman, and last, but not least, enable him to prepare himself for any criticism as to the already fixed piecework price which the workmen might think fit to make.

Piece Work.—In all the foregoing I have assumed that the works are run upon the piecework system. A paper might be written on this subject alone. Some years ago a good deal was heard of the premium bonus system, but latterly not so much seems to have been heard of it, although quite recently attention has been drawn to it again. All systems, whether piece or premium bonus or any other, are simply means to an end, viz., to induce the feeling in the workmen, firstly, that if he falls below a certain minimum of productiveness his work will cease; secondly, and what is of greater importance, to bring to bear on the man the incentive to greater production, of personal gain. I am of opinion that in a well-organised works the second of the above two results is of the more importance, as in such a works the average productiveness will be got out of the men even if they are on day work. In such a works the introduction of piecework can result in considerable increase of output and diminution of costs.

On the other hand, in a badly organised works the former is the more important result, as in such a works, if the system is day work, the workmen would waste time either intentionally or otherwise, whereas piecework does ensure a certain minimum of work at least being secured for the wages paid. There can be no doubt that the premium bonus system is very unpopular among workmen. The reason of this is, I think, that owing to the complexity of the system, the workman is never sure of what he is earning. The simplicity and sense of fairness of getting a certain price for a certain job, which are characteristic of piecework, appeal to him, and there is, no doubt, that the system, if properly worked, will result in the elimination of all superfluous energy, and secure the maximum return for the minimum effort. It is essential in these matters not to neglect the personal element. The workman must not get it into his head that he is regarded merely as a machine to be squeezed and speeded up regardless of his personal welfare. If he becomes possessed by this notion, then no system in the world will make him efficient, and in the long run the works will suffer.

The great thing in all cheapening of production, as regards labour, is to cut out superfluous effort. The ordinary man if given a job to do, will, with the best intentions in the world, usually make at least three times as much movement, and expend three times as much energy on the job as are really necessary. Everybody who has had anything to do with a workshop will have come across many instances of this phenomenon. It applies especially to bench work. The benefit of the piecework system is that it forces both foremen and workmen to find out where this wasted effort comes in, and to cut it out. Instances could be given where it has been possible to reduce the labour cost in the ratio of 3 to 1, and where the workman has earned more at the lower price than at the higher, and certainly with no greater demand upon his physical resources. Further, when once the experience has been gained, the registration of the price ensures that it is never forgotten again. The question as to how far the piecework system should be carried away from mere repetition work is a debatable one.

For repetition work, the system cannot be questioned, but for such work as, for instance, the erection of switchboards, it is not so certain. Provided, however, that a firm control can be kept over the work by a rigid system of inspection, a consideration of the whole subject leads to the conclusion that it is best to carry the system right through the works, and cut out day work entirely, except for very special jobs—such as experimental work, &c.

I am afraid that I have departed somewhat from the strict title of this article, as it is impossible to consider the matter very far without taking the subjects I have dealt with into consideration. It will be seen, however, that the main thing that I wish to draw attention to is the necessity of having a system of account keeping at work, which will serve as an indicator from week to week and month to month as to how the work going through is affecting the balance-sheet at the end of the year. The actual profit and loss on each job as it is finished is shown as a proportion of the final profit or loss. By adding up all the profit or losses on all the jobs in this way the final profit or loss is obtained. All these figures appear in the official books.

What is often done now is that costs, as such, never appear in the official books at all. Wages paid out and money spent on material are debited to manufacturing account directly, and not in the form of costs on definite order numbers. It is true that where this system obtains, costs will often be worked out, this being done under the assumption of a certain formula to cover establishment charges. These costs, however, are something outside the official book-keeping, and, in fact, could all be destroyed or not kept at all, without affecting the books in the least. On the other hand, with the proper system it would not be possible to keep any books at all if the costs were not recorded, as the former are kept in terms of the latter, and the destruction or loss of the costs is tantamount to the loss of the ledgers of the firm.

At the risk of repetition I would emphasise the great advantage that this system of book-keeping gives to the manager. Without it he has to rely on general observation, the taking out of isolated costs, &c., as to the advance the concern is making from stock-taking to stock-taking. With it, on the other hand, he knows exactly from week to week the progress, *i.e.*, the profit or loss being made, and the exact state of efficiency of his works.

Bonus. — Now this determination of profits from month to month renders possible a very advantageous system, viz., the payment to foremen, &c., of a bonus depending upon profits. It is usual in some concerns to pay departmental managers bonuses or commissions upon profits; this, however, is not extended to the foremen. On the other hand, a good deal of the possible profits will depend upon the way the foremen carry out their duties. As regards the workman, we provide an incentive to his efforts by paying him by the piece; in a similar manner for the foremen, some method should be found whereby he will immediately benefit for his extra exertions.

It would be no good to endeavour to do this by paying him a commission or bonus at the end of the year. This is much too far off, and the result of his work too remote to be

of any use to the end in view. Such a foreman's bonus or commission should be paid once a month at least. An analogy in this matter is the bonus often paid to the stokers in electrical power stations in return for low coal consumptions per unit. It would be ineffective in such a case to offer the stokers a bonus or commission on the yearly profits of the undertaking. This is a thing altogether out of their control. The coal consumption is, however, directly under their influence, and is determined week by week, so that the result of their efforts is seen and paid for immediately.

If this system is adopted for a manufacturing works, the foreman will be paid a certain salary plus a monthly bonus depending on the difference between the selling price and the costs. As each works order number is closed, the costs are determined and the monthly bonus is worked out for all works order numbers closed during the preceding month. The man, therefore, sees immediately in a tangible form the direct results of his efforts. The indirect effects of this system are, however, equally great, as it forces everybody to evaluate everything in terms of pounds, shillings and pence. Machine hands idling at the completion of their jobs waiting for the tool setter to come along and to set up, become so much money steadily being poured down the gutter, and the fact is forced home that the criterion of the continued existence of the concern is the making of a profit. It may be added that this method of payment of bonus may be well extended to all occupying the leading manufacturing positions, such as the chief draughtsman, chief tester, &c.

Use of Cost Records for Estimating Purposes.—As has been stated above, the function of the cost-keeping department is to determine the true cost of all work carried out. In some works, however, the so-called costs are not this, but consist of estimates or theoretical costs, based, it is true, upon labour records and estimates of cost of material, tabulated for the purpose of guiding the estimator when tendering. Such estimates perform an excellent purpose, and are very necessary in their proper place in the estimating department. Every estimator who knows his work will have a file of such estimated cost prices, and will revise them from time to time as the results of the actual work done come through. It is quite wrong, however, to call these estimates the works costs. These will be greater or less than the estimates, according to the way the work is put through, and one of the chief uses of accurate cost-keeping is to provide a check on the work of the estimating department. The profit or loss on every job being determined, it is possible to find out whether accurate estimates are being got out or not. If it is found, either on putting the work in hand—that is to say, on pricing the piecework tickets—that the estimated labour cannot be kept to, or, on the other hand, it is found that the cost of material is high, the matter can be immediately investigated and corrected for the future. Naturally, when any new work is put through the works, it is the business of the price fixers to see that the sum total of all the labour tickets comes within the allowed-for figure. Thus any mistake can be found before the loss is actually incurred, and very often steps can be taken to minimise, if not avert, the loss.

The determination of the tendering price will be based upon the estimated net costs of labour and material under the assumption of a certain formula; generally a certain percentage will be added to material and labour, plus a percentage on the total of the two. The object of these percentages is to cover establishment charges, and risk of loss in general. For example, in handling material there is always the risk of waste, and it is right in estimating to add a certain percentage to the bare material to insure against this. The total so obtained is, however, in no sense a works cost, but is simply an estimate which, if made up correctly, will yield a result which will be found to cover the works cost when the latter has been obtained.

Expense of Cost Keeping.—An objection that is sometimes lodged against accurate cost keeping is that it is too expensive to carry through. It is not possible to deny that there is some force in this objection. Considering, however, the great advantage to be attained, it cannot be said to be an excessive item. An approximation of the probable expense in a general electrical engineering works would be 1 per cent. of the output. Thus a works having an output of £100,000 per year would have to spend about £1,000 a year if its costs were kept on the system advocated in this paper. This is, of course, in addition to the ordinary accounting expenses which have to be met in any case. It may be safely asserted, however, that the savings effected will out-balance the expenditure many times over.

ELECTRICAL NOTES FROM INDIA.

[FROM OUR SPECIAL CORRESPONDENT.]

Allahabad Exhibition.—This Exhibition is now drawing toward a close, and it is difficult to say yet whether or not the authorities are satisfied with the results. The attendance, though large, was not so great as was anticipated; but the ultimate object of the Exhibition was not so much to show good financial results, as to educate the public, and particularly the Indian ryot and capitalist, and demonstrate to them the possibilities of modern machinery as applied to the various agricultural, manufacturing, and kindred industries, and familarise them with working results.

Most of the rewards for exhibits have been made known, and it is considered that these have been distributed with too lavish a hand. Gold, silver and bronze medals have been scattered broadcast, and there are very few exhibitors who have not had honours thrust upon them. In the engineering section alone 115 gold, 60 silver and 50 bronze medals have been given away, and it is reported that there are but few disappointments.

From an exhibitors' point of view, the results, in spite of the harvest of awards, have not been reassuring. Very few direct sales have been effected, although big promises were made by the Government authorities; much murmuring has been heard in the exhibitors' camp—enough to suggest the thought that at the next Government-supported exhibition many names, now familiar at Allahabad, will be absent.

Madras.—There is a scheme on foot for street lighting; the present experimental lighting in Mount Road is a conspicuous success, and therefore further extensions are recommended. Information may be obtained from the Municipal Secretary, Madras.

Madras Club.—There is also an opportunity in the offing for supplying either rotary transformers or a new generating plant for this—the finest club in southern India; particulars of requirements can be obtained from the secretary. If the Madras Supply Co. come to terms with the club authorities, rotary transformers may very likely be decided upon. There are, however, several electrical members in the club, and consequently diverse opinions, and in a multiplicity of opinion there is confusion.

Tata Hydro-Electric Scheme.—This huge Bombay scheme has been very fully dealt with in the home daily papers, *Reuter* even thought it worth while to cable a condensed article from the *Times* on this important matter. The undertaking is bound to assume huge proportions eventually, and one of the signs of the times in India is that the scheme is to be financed by purely Swadeshi capital, or, in other words, capital subscribed by natives of India only. The Governor of Bombay, Sir George Clark, has shown his wisdom and foresight in giving his whole hearted encouragement to the founder, and success, so far as can be foreseen, is already assured. Home manufacturers should watch developments carefully, as with the inducements offered, and the motor load anticipated, a large business is sure to be done in motors for mills. The Parsee millowner buys largely direct from home, but he is equally impartial as to choice of English, American, or German goods, provided he gets value for his money.

The Nepal hydro-electric scheme is nearing completion, and the Durbar is calling for native shift engineers to run the power station. The salaries offered, namely, 1,000 rupees a month, equivalent to £66 13s. 4d., with quarters, will probably cause home shift engineers and possibly even some chief engineers to envy their Aryan brothers. None but natives need apply however, and as there are probably not yet a round dozen native engineers in India with the required qualifications, competition will not be severe.

This is another sign of the times in India, and is a proof that it is not cheap labour which is sought for, but rather sheer willingness of the Nepal Durbar to follow Swadeshi principles. America is training a host of Indian native engineers. When they return to India, after a couple of years in Schenectady, they may be recognised by their Yankee accent, the cut of their clothes and their big talk of what they will do to shake up sleepy old India. That they are doing things in Mysore, Cashmere, and shortly in Nepal, cannot be denied.

The advertisement in one of the Indian papers reads as follows:—

SINGHA DURBAR, NEPAL.—WANTED.

APPLICATIONS are invited for the following posts *from natives of India only*. Applicants must in each case give full particulars of training and experience, with copies of recent testimonials, also age, caste and date when services would be available.

Shift Engineers.—Applicants must have been in charge of a shift and had experience in E.H.T. three-phase work and preferably with hydro-electric plants. Salary, Rs. 1,000 and unfurnished quarters.

Working Foreman Wireman with experience in carrying out work in large buildings. Preference to man with experience in loop-in, cleated system. Must be used to control of men. Salary according to qualifications.

Wiremen with experience as above. Salary according to qualifications.

Applications to be addressed to—

GOVERNMENT ELECTRICAL ENGINEER, NEPAL.

A NOVEL TORSION GAUGE.

BY DR. ALFRED GRADENWITZ.

THE want of a gauge allowing the efficiency of rotary engines to be measured has been keenly felt of late years, in view of the increasing use of steam turbines for ship propulsion.

All the apparatus so far constructed for this purpose are based upon the supposition that the shaft used for power transmission will twist through a measurable angle over a length of 3 to 6 ft., this angle, in the case of the usual material, being accurately proportional to the acting force. By ascertaining this angle, the energy transmitted can be gauged.

The only distinctive feature of the various types of torsion gauge is the method used for measuring the angle. A novel scheme, designed by Mr. Rambal, uses for this purpose electrical contacts, thus avoiding any rotary parts outside the gauging disks, and making the apparatus less complicated and expensive.

Fig. 1 shows schematically the principle and working of this apparatus, which is constructed by H. Maihak, of Hamburg.

At two points of the shaft a, the torsion of which is to be measured, there are mounted the disks b and b_1, carrying at their circumference the contact pieces c and c_1. Opposite these contact pieces are fixed the contacts d and d_1, one of which is stationary, while the other is movable in a guide g, concentric with the disk.

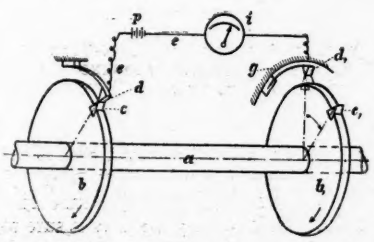


FIG. 1.

The contacts d and d_1 will touch lightly the edges of c and c_1 during each revolution of the shaft. They are insulated and connected together by a copper wire e, in series with a battery p and an ammeter i.

If the contacts c and c_1 pass the contacts d and d_1 exactly at the same moment, the circuit will be completed through the disks b and b_1, the shaft a, and the wire e, and the ammeter i then indicates the passing of an electric current. The contacts should be so adjusted as to cause c and d, as well as c_1 and d_1, to touch one another when the shaft is running at no load. As soon as the shaft begins to transmit energy, the contact c will be made to advance in regard to c_1 by a certain angle, which is the angle of torsion to be determined. In order to effect this measurement, the contact d_1 should be pushed back on the guide g, until i indicates the passage of a current. The angle traversed on the scale of the guide g is then equal to the angle of torsion.

In practice it is preferable to detect the passage of current by means of a telephone. The current can be supplied by a battery of dry cells.

Fig. 2 shows the design of the measuring disks b and b_1. These are as light as possible, each consisting of two parts, so as to be

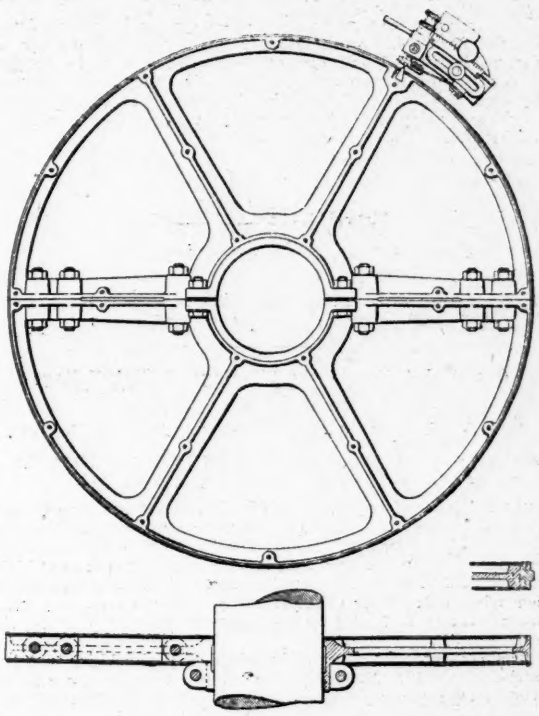


FIG. 2.

readily mounted on the propeller shaft. In order to avoid accidents, they are covered with protective sheet metal.

One of the disks can be installed close to the turbine in the engine room, whereas the other is fitted as far aft as it can be, towards the stern of the vessel, in order to include a length of shaft as great as possible, and thus the highest possible accuracy. The stern disk is provided with the stationary contact, and does not require any

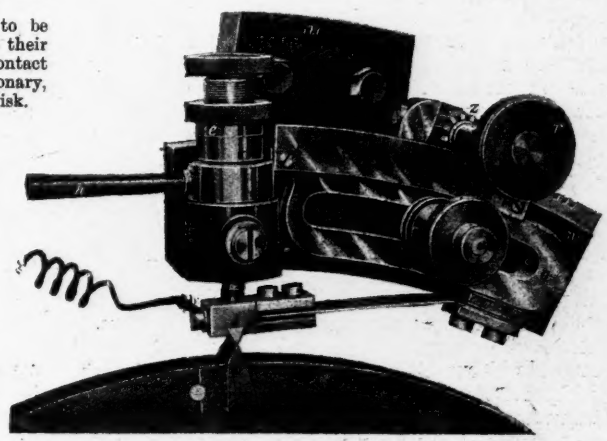


FIG. 3.

superintendence, whereas the movable contact, which is used for measuring, is located in the engine room.

The design of the movable contact and contact-bearer is represented in fig. 3. The contact d is fixed with a spring to the slide g, which is so designed as to be susceptible of a displacement concentric with the shaft. For this purpose, the slide g carries a toothed arc with which meshes the toothed wheel z, located in n, the rotation of which is effected by means of a small hand wheel r. The displacement of the slide and contact is read from a scale connected with g and graduated in degrees or units of power, the slide being arrested at the very moment the telephone indicates the current closure, which occurs at every revolution.

The contact proper d consists of a short edge made of hardened

steel, like the counter-contact c, which, as represented in fig. 3, is rigidly connected with the disk. The accurate adjustment is effected by means of the screw e; the lever h allows its thrust pin to be lifted after the reading has been taken, thus disengaging the points d and c.

The design and shape of the other pair of contacts are the same, the shifting device being omitted. The plate should be fitted to a conveniently fixed support in a proper position with regard to the disk. In fixing the piece $n_1 n_2$, care should be taken to place the circular guide of the slide g concentric with the shaft.

This torsion meter affords the advantage of being readily fitted to any shaft without any alteration or unmounting, and of allowing the whole available length of shaft to be utilised so as to increase the accuracy of measurements. Being absolutely independent of any mechanical reduction and the like, as well as of resistances, &c., the measuring of the torsion angle is not subject to errors of backlash, &c. The readings are very easy to take.

PROCEEDINGS OF INSTITUTIONS.

Chemical Action in the Windings of High-Voltage Machines.

By A. P. M. Fleming and R. Johnson, Associate Members.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Manchester, February 14th*, 1911.)

During the past few years considerable interest has been aroused by the failure of certain high-voltage machines due to chemical corrosion of the slot insulation. Trouble of this kind has been experienced by practically all the leading European makers of high-voltage machines; and, in one instance, at least, a machine that had failed on account of chemical action was re-wound for a lower voltage and step-up transformers were supplied by the makers gratis.

The case brought forward by Mr. J. S. Highfield in 1905 had reference to a 10,000-volt two-phase alternator, operating with one side of each phase grounded. In this machine the conductors were covered with varnished cotton braid and threaded through solid micanite tubes contained in the slots. Failure occurred after about one year's service. The insulating braiding on the portions of the conductors contained in the tubes at the ungrounded ends and for some distance into the windings had rotted away, leaving a green deposit on the copper. An analysis of the products showed the presence of nitric and sulphuric acids. The former was attributed to an electrostatic discharge across the air-spaces surrounding the conductors, it being well known that when a discharge takes place in air, ozone and oxides of nitrogen may be formed, and from the latter, nitric and nitrous acids if moisture is present.

The cases investigated by the authors comprised a number of machines, both two and three phase, where the maximum R.M.S. voltage to ground varied from 3,500 to 7,500. Some of these machines were hand wound through tubes made up of paper and mica. Others had former-wound coils insulated in some cases by wrappings of oiled cambric and mica, and in others with paper and mica tubes drawn over the slot portions. While the amount of chemical action varied with the method of insulation employed, the effects produced were in all cases very similar. One example only need therefore be described: that of a 7,500-volt two-phase generator operating with one side of each phase grounded.

A section of the slot portion of one of the coils in this machine is shown in fig. 1. The coils were former wound, and the insulating tubes drawn over the slot portions. This necessitated the margin noted in the figure by the variable air-space between the conductors and the inside of the tube. The ends of the tube were sealed by a taping of linseed oil-treated cambric extending around the end portions of the coils.

The machine failed after three years' continuous service, due to a short circuit between adjacent conductors near the ungrounded end of one phase. This caused a burning of the tube, and ultimately the winding grounded at this point. An examination of the damaged coil showed evidence of considerable corrosion of the conductors. On removing the remaining coils traces of the action were found to extend about half-way round each phase, *i.e.*, to a point having about 3,500 volts to ground. The insulation inside the tubes on the coils at the ungrounded end was very sticky, although all the varnished surfaces had originally been thoroughly hardened.

On the untaped half of the coil (see fig. 1), the insulation on the conductors was reduced to a greenish white powder, the structure of the cotton covering being entirely destroyed. On the taped half, the oiled cambric was bleached and very rotten, and the varnish and cotton covering corroded away, except where the taping had been pressed tightly between the conductors and the inside of the tube. The action extended partly between the two sections and about 3 in. beyond the ends of the slots.

The insulating tubes were unaffected chemically, but innumerable perforations were observed in the outside surface in lines marked by the serrated surface of the laminations. This action did not extend nearly so far around the windings as the internal chemical action. On the coils of 3,500 volts to ground the action was very slight; the conductors were only attacked on the untaped section in a few small spots; the oiled cambric on the other section, while affected in patches, had prevented any action on the conductors underneath.

Traces of nitric acid were found on the coils at the ungrounded end of the winding. On lower voltage coils no nitric or other mineral acid could be detected. The green deposit on the copper underneath the corroded cotton covering proved to be an organic salt.

Chemical action was generally found to be confined to the spaces immediately surrounding the conductors. In the case of an 11,000-volt three-phase machine, however, strong evidence of chemical action was found in the middle of the slot insulation where a cavity in the material existed. The insulation in this case consisted of a wrapping of mica backed with linseed oil-treated cloth, and the latter had been destroyed on the surface of the cavity exposed to the discharge.

From investigations of a number of machines insulated in different ways the authors arrived at the general conclusion that the destruction of the insulation was not necessarily due to the formation of nitric acid. For instance, in the case of the 7,500-volt machine already referred to, there were traces of nitric acid on certain of the corroded coils only. Further, the corrosion on the conductors was of an organic nature.

The chemical action only occurred where air-pockets existed in the slot insulation or around the conductors, and only in those machines having high enough voltage to produce a discharge across these spaces.

In the case of the 7,500-volt machine it was evident that the most likely source of organic acids was the varnish treatment on the insulating materials. The varnish was of a type very largely used in the insulation of windings, and consisted largely of linseed oil and certain resinous gums. Such varnishes dry by oxidation until a hard brittle surface is formed, and under ordinary conditions of drying and heating the oxidation proceeds too slowly beyond the hardening stage to introduce any element of risk. It is possible, however, under certain conditions, to carry this action much further, causing what is termed super-oxidation, which, in the case of varnishes of this kind, produces an entire change from a hard to a soft pasty condition.

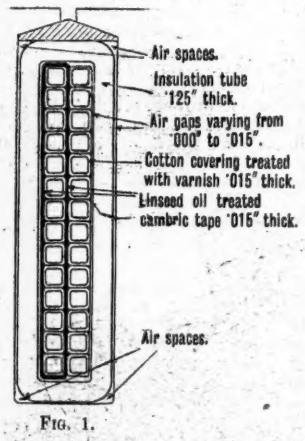

Air spaces.
Insulation tube '125" thick.
Air gaps varying from '000" to '015".
Cotton covering treated with varnish '015" thick.
Linseed oil treated cambric tape '015" thick.
Air spaces.

Fig. 1.

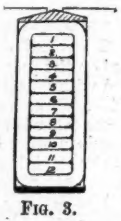


Fig. 3.

Fig. 4.

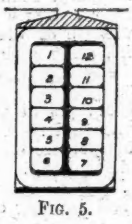


Fig. 5.

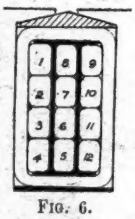


Fig. 6.

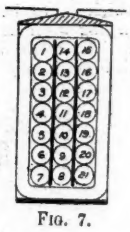


Fig. 7.

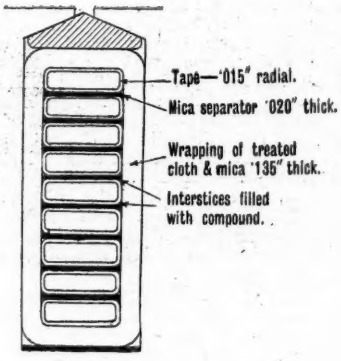


Fig. 8.

Fig. 1.—Section through Slot of 7,500-Volt Two-Phase Stator Winding in which Failure Occurred due to Chemical Action.
Figs. 3 to 7.—Methods of Arranging Conductors in Slots.

Fig. 8.—Section through Slot of an 11,000-Volt Three-Phase Star-Connected Generator, showing Best Method of Grouping and Insulating for High Stresses.

From the pasty nature and general characteristics of the varnish in this machine, super-oxidation of the linseed oil on the cambric, and of the varnish on the cotton-covered conductors, had evidently taken place. This was attributable to the presence of ozone, oxides of nitrogen and nitric acid, all of which are powerful oxidising agents.

An ozoniser was constructed consisting of a number of glass plates 0·100 in. thick, coated on one side with perforated copper foil, and separated by air spaces ranging in thickness from 0·03 in. to 0·200 in. An alternating voltage of from 3,000 to 10,000 volts was applied between adjacent electrodes, and a temperature of about 70° C. maintained throughout the tests. There was access of air to the ozoniser.

Tests were first made on sheet insulating materials, comprising untreated and linseed oil-treated cambrics, micanite, plain papers, and papers impregnated with a number of different varnishes, compounds and waxes. Strips of these materials were suspended in the air-gaps between the plates.

With voltage sufficient to produce visible and audible discharge, copper nitrate was formed on the electrodes within three days. The test was continued for about three weeks, when it was found that a number of the varnishes showed marked evidence of deterioration. The samples of untreated cambric and paper, particularly the former, were riddled with perforations and their fibrous nature very largely destroyed. The linseed oil-treated cambric was partially bleached and very pasty. The other varnish-treated materials had been similarly affected, but to a smaller extent. Papers treated with an asphaltum compound were hardened to a slight extent, but others treated with paraffin wax were apparently unaffected. As regards the micanite samples, the mica itself was unaffected, but some action was observable on the varnishes used for cementing the laminæ together. Comparing the samples with similar material taken from the machine already referred to, the nature of the deterioration was found to be practically the same in each case.

The tests were repeated on new samples, with the voltage reduced to give a barely perceptible discharge. The tests had to be carried on for over six weeks before a definitely marked change in the condition of the materials could be observed. It was then seen that the effects produced were distinctly comparable with those on the similar materials subjected to the intense discharge. While ozone was undoubtedly formed, no appreciable amount of the oxides of nitrogen was present.

Further tests were made on samples of thin copper ribbon. Certain of these were insulated with cotton covering, some untreated and some impregnated with the various varnishes employed in the previous tests; others had simply a coating of these varnishes or compounds, without any cotton or other insulating covering. The tests were carried out under the two extreme conditions of discharge as before, and similar effects produced on the insulating materials, indicating that the presence of the copper had no direct influence on the deterioration of the insulation.

Certain varnishes—notably those of the linseed oil gum type—produce a slight green organic deposit on copper, independent of any chemical effects produced by discharge. In the case of conductors treated with such varnishes and exposed to discharge in the ozoniser until marked deterioration of the varnish took place, this organic deposit was found to be considerably increased.

The results of the foregoing tests indicated that, except in the rapidity of the action, the effect on the insulating materials was generally the same with either ozone, oxides of nitrogen, or nitric acid.

The occluded air in machine windings is liable to continual displacement, due to the alternating heating and cooling setting up what has been aptly termed "breathing" action. To determine the effect of this on the amount and rapidity of the chemical action, tests were made on short lengths of insulated conductors inserted in glass tubes, and generally comparable as regards air cavities with a high-voltage coil.

When the ends of the tubes were left open, the chemical action went on freely; when the ends were carefully taped up and varnished, like the ends of slot insulation, the chemical action proceeded steadily but much more slowly. When the tubes were hermetically sealed, the small volume of air produced very little chemical action, and this proceeded only for a short time, as the air could not be replenished by "breathing."

Pressure tests on the decomposed materials taken from coils on which no nitric acid had been found showed these to be of comparatively high insulating value, and not dangerously hygroscopic. Where there was nitric acid, however, and it had attacked the copper, the nitrate thus formed, being of a highly deliquescent nature, was readily conducting. Also where free acid was present in the decomposed insulation, this, for the same reason, considerably increased the conductivity.

In considering the voltage distribution across dielectrics made up of layers of different insulating materials, it was noted that, apart from effects produced in air-gaps, the solid insulation might in some way be directly affected. For instance, where the dielectric is composed of two layers of different materials, one of high and the other of low specific inductive capacity, the voltage across the latter might under certain conditions be higher than its disruptive value, although the insulation as a whole was quite able to sustain the entire voltage applied. To determine the effects on solid insulation under these conditions, tests were made with a dielectric composed of sheets of equal thickness of glass and paper. Teste were first made to determine the voltage required to puncture the paper. Voltage was then applied to the entire dielectric so as to give a component (about 75 per cent. of the total voltage) across the paper, computed to be well above that required to produce its disruption. The result was to riddle the paper with minute perforations, which consequently reduced its insulation strength to a fraction of the original value, as shown by breakdown tests that were subsequently made. These tests were carried out with well-dried paper. It was interesting to note that with the paper in its normal condition, *i.e.*, containing about 7 per cent. of moisture, the specific inductive capacity was increased sufficiently to reduce the component of voltage so much that no perforations were produced in the paper until a considerably higher test voltage was applied.

It is well known that the distribution of voltage across a dielectric made up of layers of a number of different materials varies across each layer directly as the thickness and inversely as the specific inductive capacity. Each layer may be considered to represent the dielectric of a condenser, and the total thickness of insulation a number of condensers in series.

The slot insulation in a high-voltage machine usually consists of a number of layers of different materials, as shown, for instance, in fig. 1, the specific inductive capacity of the materials used in that case varying from 1 for air to about 6 for the mica. From this it follows that where air layers exist, the potential gradient is much steeper across them than across the solid insulation.

The stress the air-gaps are subjected to in the various cases occurring in practice cannot be ascertained directly.

While chemical action has been observed on windings having a voltage to ground as low as 3,500, there are many machines that have operated satisfactorily for years at voltages as high as 10,000 to ground. Further, it is interesting to note that as far as the

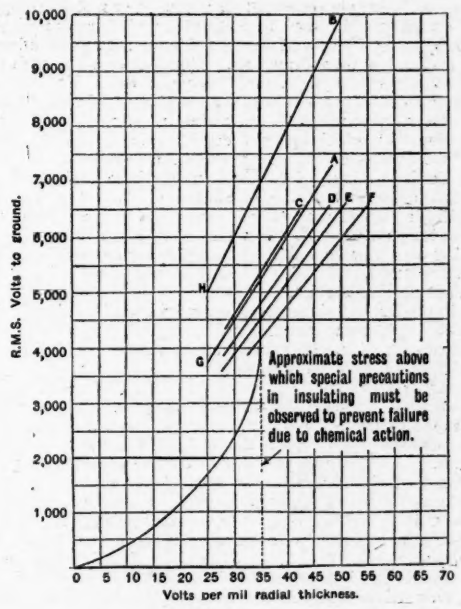


FIG. 2.

authors have been able to ascertain, all the machines that have failed through chemical action have been of European make. No instance of an American machine giving trouble could be found.

The thickness of slot insulation would appear to afford the simplest explanation of the freedom from chemical action of comparatively low-voltage machines. It has, for mechanical reasons, to be so great in proportion to the voltage that the stress across occluded air-spaces is probably well below that at which a discharge commences. To ascertain to what extent this factor applies for higher voltages, the radial thicknesses of slot insulation were taken for a number of the machines noted above that were considered to be perfectly safe, and compared with those of machines that had failed. These machines were in no way specially insulated to withstand chemical action, and other than as regards radial thickness of slot insulation, were generally comparable with each other.

From these data it was seen that, for a definite voltage, there was a fairly definite radial thickness of insulation that could be considered safe irrespective of the method of insulating. The curve in fig. 2 was plotted from the figures thus obtained and from the radial thicknesses of insulation commonly used for lower voltage machines. This curve shows the relation between voltage to ground and average voltage stress across the slot insulation. The stress is expressed in volts per mil of the total radial space in the slots between copper and iron.

While the authors know of no case where failure has occurred at a stress as low as the maximum indicated on the curve, they have observed, in several cases, definite traces of chemical action where the stress has been as low as 25 volts per mil. The action, however, has been too slight seriously to impair the life of the insulation.

The straight lines cutting the curve indicate, for a number of different makes of machines, the range of voltage over which chemical action has been observed. All these failures have occurred near the extreme end of the winding, and the stresses at these points are indicated by A B C D E and F. The line A G refers to the 7,500-volt two-phase machine already referred to, and B H to the example described by Mr. Highfield. The lower extremities of the lines only represent approximately the stresses at which chemical

action ceases, as at these low voltages the evidence is very indistinct.

The value of 35 volts per mil shown on the curve in fig. 2 may be considered to represent the safe average stress even for machines affording every facility for chemical action to take place. Many machines may operate safely at a much higher stress than this without being specially insulated to prevent chemical action.

With improvements in insulating materials and the methods of applying them, together with the necessity for high copper space-factors incident to keen competition, the tendency among European makers has been to force the stress on the slot insulation much higher than has been the general practice in America. In dealing with stresses higher than about 35 volts per mil of total slot insulation, it is necessary to eliminate air-spaces as far as possible, to employ insulation that is not readily affected by chemical action, and to reduce to a minimum the stress across any existing air layers. The authors know of several machines that have operated safely for years at an average stress as high as 60 volts per mil where the proper precautions have been observed. It should be noted, however, that the stresses reached when pressure-testing machines for such severe working conditions, fall within the range of those liable to produce partial breakdown of insulation in the manner already noted.

The importance of impregnation of windings in general insulation work is now fully appreciated, but the limitations as regards filling the interstices in windings are by no means generally recognised. In the most modern method of impregnating coils, these are dried under vacuum in a suitable steam-heated chamber to remove moisture and occluded air; varnish or molten compound is then drawn in and forced into the coils under an air pressure of 50 to 60 lb. per sq. in. applied for several hours; the surplus impregnating material is then drawn off. The ideal result of such treatment is a completely solid, moisture-proof coil. Unfortunately such a result cannot be obtained commercially. If varnish is used as the impregnating material, interstices must necessarily be left when the solvent, which forms a considerable portion of the bulk, is expelled. When compounds are used, the choice of material is limited by the melting point, which must be so high that there is no tendency to flow at the maximum working temperature of the windings. At the same time, the compound must become very fluid at a temperature well below that at which the cotton or other insulating coverings to be impregnated become damaged. Further, it must not become brittle at the lowest temperature to which it may be subjected in service.

Within the limits imposed by these requirements, it is practically impossible to obtain a material, otherwise suitable, with a low coefficient of expansion. Ordinarily there may be as much as 10 per cent. difference between the volume at normal and that at the impregnating temperature. Interstices will therefore be formed by contraction of the compound when it cools. Further, where there are air-pockets in the interior of the coil other than of dimensions comparable with the capillary tubes in the fibrous materials, it is impossible to fill them except under very prolonged treatment. This is due to the exceedingly small and tortuous channels through which the impregnating material has to travel. Moreover, it is nearly impossible within practical limitations to impregnate a completely insulated armature coil on the slot portions, since the insulating materials ordinarily used on these parts are almost impervious to impregnating compounds; and further, a much higher pressure than can ordinarily be applied is necessary to force the compound in from the ends throughout the length of the coil. It therefore becomes necessary to impregnate the formed coils of high-voltage machines before the slot insulation is applied. Even when this is done, additional processes are required to ensure that all spaces between conductors are properly filled, and a smooth plane surface prepared on which to press the slot insulation. A further treatment by impregnation, after completely insulating, is desirable, as a means of sealing the ends of the insulation on slot portions and to give a moisture-resisting covering to the entire coil. These precautions, while affording a solid coil at normal temperatures, only partially achieve the desired result, since the whole of the insulation swells when the windings are heated and does not contract and occupy its original position on cooling. Cavities are liable, therefore, to be formed around the conductors into which air will eventually percolate. Moisture may also be absorbed by the breathing action.

Owing to the difficulty of making a solid coil by impregnating and filling processes, it is necessary to consider the best arrangement of conductors which will reduce to a minimum the interspaces to be filled. This is further necessary inasmuch as spaces, other than those across which a discharge may take place, act as a reservoir and replenish the air acted upon by the discharge. This occluded air also assists in setting up breathing action.

Rectangular conductors should be used, and, when possible, be chosen of such a shape as to give a single-section arrangement, as shown in fig. 3. Even when it is necessary to use two rectangular conductors in parallel side by side, as shown in fig. 4, this arrangement is generally preferable to multi-section coils. A comparison of various arrangements common for coils having the same number of conductors, and the same cross-section of copper, is shown in figs. 4, 5 and 6.

As regards freedom from interspaces, the advantage of coils wound with rectangular conductors is seen by comparing figs. 6 and 7. The single-section arrangement with rectangular conductors gives a very solid coil, mechanically well adapted to withstand the handling during the application of the external insulation. Failure from chemical action is almost invariably the result of short circuits between conductors; it is, therefore, desirable that the voltage between adjacent turns should be kept as low as possible. The single-section coil is ideal in this respect, and, further, this formation is such that turns of widely differing potential cannot be readily displaced to make contact during handling or in the insulating process.

As a further safeguard against short circuits, the conductors, where number and size permits, should have their insulating coverings reinforced on the slot portions by separating strips of mica or other insulation not affected by the chemical action. The single-section type of coil is best adapted to this method of reinforcement, since in the multi-section coils the conductors are usually too narrow effectively to retain the separators during handling. A typical example of a single-section coil of an 11,000-volt three-phase star-connected machine, insulated in this way, is shown in fig. 8.

The slot insulation of a formed and solidly impregnated coil can best be applied as a wrapping, hot-ironed to give a solid insulation free from occluded air.

Coils wound on formers, impregnated and completely filled and insulated before placing in the slots, afford the best type for safeguarding against chemical action. Where electrical considerations permit, open slots are preferable to semi-closed, since a smaller winding clearance can be allowed in the slots and the swelling of the insulation is consequently reduced to a minimum.

Coils wound directly into the machine by threading the turns singly through insulating tubes, while perhaps more commonly employed than any other type, are quite unsatisfactory for machines in which the stress across the slot insulation exceeds about 35 volts per mil. In such coils, round wires generally have to be used with a considerable amount of interspace in the coils, and there is no satisfactory way of filling the interstices.

Breathing action in coils takes places to a much greater extent than is ordinarily considered possible, and is difficult to prevent except with completely formed and separately insulated coils.

The application of tape or compound after coils are in place in slots—as, for instance, in the hand-wound type—cannot be made to seal up the ends of the slot insulation effectively enough permanently to prevent breathing.

Above 25 volts per mil such readily oxidisable insulation as linseed oil-treated cambric should be avoided. For such stresses the cotton covering of conductors, or other cellulose material, should be impregnated with molten asphaltum compound. The same kind of asphaltum compound should be used to fill the interstices in the coil. Untreated cotton covering and other cellulose materials are generally excluded from machine windings for any voltage. It is particularly necessary to avoid their use in high-voltage machines.

For the separators between adjacent turns, mica appears to be the most suitable material. As regards external insulation, mica backed with treated paper or fabric is very satisfactory. The mica surface should be placed nearest the air-gap so as to shield the backing material from the chemical effects resulting from a discharge.

Unfortunately, there are no materials, having very low specific inductive capacity, that are otherwise suitable for the insulation of high-voltage coils. Consequently the air-gap stress relative to that across the solid insulation cannot be reduced in this way.

A method that has been proposed for minimising the air-gap stress consists of winding between the inner layers of the slot insulation, a sheet of metal foil extending the full length of the slot and completely enclosing that part of the coil. This is connected to one of the conductors, preferably at about the centre of the coil. Under these conditions the stress between the windings and ground is concentrated on the solid insulation between foil and iron, rendering that across the air-gap practically negligible. To prevent any action due to the external gap, a similar sheet of foil may be used around the outside of the coil and grounded to the iron.

Theoretically this method is quite sound, and should enable the stress on the solid insulation to be pushed up to the limits determined by breakdown considerations. It might be specially used to advantage in the case of hand-wound coils for very high voltages. The authors, however, know of no instance where it has been used in machine work. Except under special conditions, it is very doubtful whether the method is commercially practicable.

A form of chemical action that is often confused with that produced in high-voltage windings, and is liable to occur on windings whether they are in service or not, is found on varnish-treated coils only, and is indicated by a greenish discoloration of the copper conductors and of the cotton or other insulation surrounding them. The action is due to the presence of weak organic acids.

The authors have never known of a case where it could be demonstrated that this action had appreciably lowered the insulating value or impaired the mechanical properties of the insulating covering, or, in fact, afforded any evidence of its presence, except by the colour produced.

Discussion.

Mr. C. J. Beaver said that he had made independent tests on the windings of a generator which had worked for three years at a pressure of 5,500 volts to ground, and he fully confirmed the authors' observations regarding the appearance and distribution of the affected parts. He had no hesitation in concluding, after analysis, that the very distinctly acid substances, found on the varnished and varnished cotton coverings, were super-oxidation products of linseed oil, because they corresponded very closely with the products formed by exposure of linseed oil to air and sunlight at ordinary temperatures for periods of several years. He was inclined to agree with the authors that the simple formation of ozone could be held responsible for practically all the damage. Linseed oil did not consist of organic acids, but of glycerides of certain fatty acids which were chiefly of the linolic and linolenic series. The oil films in drying passed through various stages of rancidity, until they

arrived at what was formerly regarded as the final state of oxidation. This supposed fully oxidised body was known as linoxyn. It was solid, somewhat flexible, and from the physical point of view, excellent for the purpose being discussed. It was quite neutral and insoluble in the solvents in which at lower stages of oxidation it was quite soluble. It was a very stable body, and experiments had shown that the superoxidation referred to in the paper could only be brought about under very severe conditions, such as exposure to recent ozone. The desirability of thorough drying, *i.e.*, converting the films into linoxyn as quickly as possible, was important, as the period during which simple chemical action on the conductors might occur would be minimised, and further, the action of the ozone might possibly split up the constituents more easily before they reached the more stable stage represented by linoxyn. Materials, such as asphaltum, which had to be applied in a molten state, were always to be regarded as fluids, and the very properties which minimised their fluidity under working conditions, *e.g.*, high melting point and viscosity, would militate against their initial application to the winding and interstices. Cotton yarn or fabrics impregnated with a varnish made by dissolving, say, asphaltum in a suitable solvent, stood the effects of heat much better than similar yarns or fabrics impregnated with the same compound in a molten state. This was probably due to the individual fibres being better impregnated in the former than in the latter case. In view of the aforesaid considerations, it appeared better to use varnish and varnished fabrics and to keep the maximum stress within the limits illustrated in fig. 5. The foil applied over the slot insulation and grounded to the iron was an exact parallel to the light metallic sheathing which the speaker pointed out some 10 or 12 years ago as the cure for static troubles on cables. Secondly, the metallic layer between the inner layers of slot insulation connected to one of the conductors at an intermediate voltage point was also an exact parallel to the intermediate potential distributing layer used in cables for working pressures of 50,000 to 100,000 volts. The method would probably not lead to such marked economy of insulating materials in machine windings as in cables, but it would certainly be worth pursuing.

Mr. W. Cramp said that the authors appeared to be of the opinion that nitric acid was not necessarily produced by the so-called "silent" discharge. This, however, was a mistake, as no matter how weak the discharge, a certain amount of oxide of nitrogen was produced, the amount depending upon the strength of discharge. Although chemically pure ozone would no doubt set up the same action, it could not possibly act anything like so vigorously. It was now well known that ozone produced by the electric discharge in air was accompanied by an extremely active and unstable compound of nitrogen, which so readily parted with its oxygen that it appeared to be an oxidising agent far more powerful than any oxide of nitrogen or ozone itself. He believed the presence of these extremely active bodies accounted for the destructive action illustrated by the authors, and for the action on varnishes sometimes described as superoxidation. This effect would take place more readily in damp air than in dry air, so that one of the conditions for successful insulation was dryness of air, and this was much more important than any effect of change of specific inductive capacity brought about by pressure or moisture. The authors had called attention to the fact that paraffin wax was not easily affected, but in his experience, if the discharge was sufficiently intense, paraffin wax, like other materials, would break down and become a greenish-white powder. A very delicate and valuable test for nitrous acid or nitrate was to be found in the use of "Griess" reagent.

Mr. Miles Walker said that a very marked case of the production of nitrate of copper occurred during some tests on the insulation of condensers intended for high-voltage work. During the test, which took place in air, there was a brush discharge across certain air spaces due to the capacity current flowing into the condenser. This was very analogous to the cases mentioned by the authors. The insulation behaved exactly like a number of condensers placed in series with a number of resistances. Experiments showed that these resistances were very much decreased as the temperature was raised, so that the condenser current depended upon the temperature. It could not be decided what thickness of insulation would be necessary to cut down the brush discharge unless the temperature was specified. The authors' figures might be taken at the normal machine temperatures. Large pads of insulating material were placed in an oven in which they could be raised to any desired temperature, and measurements of losses were taken by an electrostatic wattmeter at different voltages and different frequencies. The interesting result was that for a given voltage per in., a given surrounding temperature and a given rate of cooling, the conditions might either be such as to result in a steady final temperature of the insulation, or the rate of production of heat might exceed the rate of dissipation of heat, in which case the temperature would rise until a breakdown occurred. A large number of tests made on the type of insulator used on high-voltage transformers showed that where breakdowns occurred through the application of high voltage, the effects were due to the rise in temperature caused by a gradual accumulation of heat. Had the cooling conditions been better, the insulation would have withstood a higher voltage. In a word, the breakdown of paper insulation was generally due to burning, and the voltage it would stand depended upon the cooling conditions. For this reason a thin piece of insulation placed between two plates would stand many more volts per in. than a thick piece. The same law applied to the limitation of brush discharge; designers must have regard to the rate of production of heat, and the rate at which it could be dissipated.

Mr. H. D. Symonds said he had had the opportunity of inspecting several machines which had broken down due to chemical action. The first case was that of a two-phase 7,500-volt generator with one end of each phase grounded. Exactly the same phenomena as described by the authors had been observed. There was a distinct difference between the corrosion of the slot portion, and the corrosion of the coil ends due to the use of a linseed oil varnish. The coils were former wound and insulated with paper mica tubes, the failure being due to a short between turns in one phase. The coils of the defective phase fitted rather loosely, and the corrosion was much more prominent in this phase than in the other phase. An analysis of the rotted insulation proved the presence of nitric acid, and, after testing several samples, it was noted that the acidity was much more marked in the slot portions of the coils. Samples from the slot portions of higher-voltage coils showed much more acidity than similar samples from the lower-voltage coils. In view of these observations, a number of experimental coils were insulated in different ways and subjected to 6,600 volts for a long period. Breakdown commenced after six months, and periodically occurred at different intervals on different coils. Some of the coils had now stood for four years. As each breakdown occurred the coils were carefully examined, and it was interesting to note the effect of the distribution with time. Breakdown was always due to the heating of the dielectric by the discharge, since the coils were fed from a transformer, the voltage being applied between the conductors and an outside metal wrap. Where the wrap was of copper, corrosion set up on the inside of the wrap. The authors stated that the presence of copper did not help the chemical action. This was contrary to the speaker's experience, as once the insulation became deteriorated, its close proximity to the copper rendered the formation of a copper salt easily possible, and once started it would soon form a short between conductors. A tinned copper wire used as a lead on the high-tension side of a testing transformer showed no signs of corrosion after 15 months, whereas a bare copper wire was badly corroded with copper nitrate in three months. Regarding the use of a metal sheath around the outside of the conductor and insulation, this was obviously difficult to accomplish, but the speaker had made up a series of coils in which the varnished cotton covering of the conductors and the inside and outside of the insulating tubes were coated with aluminium powder such as is used in aluminium paint. The coils had been run at 6,600 volts, and the average life was greatly increased by the application of the aluminium. Furthermore, there was no destruction of the insulation or other corrosion, and analysis showed no signs of the presence of nitric acid. In high-speed machines where ventilation was likely to be at all violent, the aluminium powder might be objectionable, but a careful method of applying it might overcome the difficulty.

Mr. J. S. Highfield wrote that all the coils he had recently used for large alternators were wholly insulated with mica and a filling compound. As the authors stated, it was not possible to fill in every air space owing to the contraction of the materials used when cooling. Where small spaces were left, he had found a slight amount of deposit, but this seemed to reach a limit, and he had had no difficulty from this cause for several years. He was inclined to believe that a pressure of 10,000 volts to earth was quite the maximum pressure at which it was commercially sound to wind high-tension alternators, and then only when of large size. It was impossible to make the factor of safety as high for high pressures as for low pressures, and coils should be wound for so high a pressure only in the case of slow-speed alternators; turbine alternators should not be wound for such high pressures unless much larger factors of safety could be obtained. In the case of the failure of the insulation in a turbine alternator, particularly where end shields were used so as to enclose the whole machine, according to his experience, complete destruction of the winding took place; that was to say, in the case of a burn-out, the insulation was so damaged that every coil had to be re-insulated, whereas, with slow-speed alternators, only one or two coils were damaged and the repairs could be carried out in a day or two, but in the case of a turbine alternator the repairs took as many months. With the large units now being installed, the long period required for reconstruction involved the use of a very large percentage of spare plant. For machines of 3,000 kw. and under, the maximum pressure to earth should not exceed, say 5,000 volts. In the long run, it was cheaper to wind the alternators for a low pressure, and use step-up transformers. The green discoloration occurring with certain classes of varnish appeared to be quite harmless.

Mr. P. V. Hunter wrote that the various supply companies in his district had never experienced any trouble due to chemical action in the windings of high-tension machines. The only interesting chemical effect of which he had any record occurred in some tubular floor insulator bolts for 20,000 volts and 6,600 volts. The insulators were grouted in the floor, projecting several inches on each side. The bolts were slightly longer than the insulator and a loose fit in it, with washers and nuts at each end to keep them in position. The bolts were of Muntz metal, having the following composition:—Copper, 57·76 per cent.; lead, 2·22 per cent.; zinc, 39·7 per cent.; arsenic, ·05 per cent. Shortly after a few of these bolts were put into commission one of them fractured inside the insulator and the bottom portion fell away. On examination, the bolt was found to have a greyish-green deposit on it, and was full of longitudinal fissures extending sometimes for practically the whole length of the bolt and radially towards the centre, or occasionally the fissure after travelling from the outside some distance towards the centre of the bolt would change its direction and travel circumferentially. The effect was extremely remarkable in appearance, and reminded one of a piece of bamboo which had been pounded with a hammer so as to produce longitudinal cracks in it. The matter was submitted to the National Physical Laboratory, and in their report on the matter, they attributed the cause of the trouble to the lead in the composition of the bolt. This tended to make the Muntz metal brittle

when hot, so that in rolling the insulator bolts fine rolling cracks were formed. These could be seen under the microscope in bolts which had never been used, although to the eye they were perfectly sound and homogeneous. The development of the cracks was due to the potential giving rise to the formation of oxides of nitrogen and nitric acid fumes in the practically closed space between the bolt and the inside of the insulator. These fumes readily penetrated the fine rolling cracks and caused the formation of basic nitrates within the cracks. The formation of the latter was accompanied by considerable increase in volume, which would ultimately cause the cracks to widen and produce the complete fissuring of the bolts, as experienced. The whole action was similar to the manner in which frost burst rocks or other material into which water had percolated. He had a very strong preference for one conductor per slot, particularly in the stators of three-phase generators, and where it was necessary to transform he felt strongly that the generator pressure should be so fixed that this type of winding could be obtained. With one conductor per slot it was possible to insulate the conductor in a very sound and homogeneous manner, excluding all air.

Mr. H. W. Turner wrote that he was inclined to think that cause and effect had often been confused when dealing with insulation breakdowns. As an example, ozone, nitric acid and sulphuric acid—due to the presence of moisture and cellular air spaces in the windings—might have been caused by a prolonged excessively high-potential test on the machine before it left the works and was put into regular service. Had the machine been warmed up on the test bed and given a good long overload test, so that all moisture might be driven out, and had the pores then been filled up while the machine was very hot with a good non-volatile air-drying varnish, and allowed to cool before applying the flash test, there would have been fewer insulation troubles after many years of service. The authors' experience confirmed the writer's regarding the harmlessness of the green discoloration on copper. It was a most deplorable fact that drying and baking facilities were seldom intelligently provided and maintained. Many so-called ovens either had too low or irregular temperature, or else put more moisture into the goods than they extracted. The authors stated that "untreated cotton covering and other cellulose materials are generally excluded from machine windings for any voltage." His experience proved quite the reverse. He believed that perfect impregnation of all cotton-covered wires while hot with cold non-volatile black varnishes before the wires were wound up into coils of any sort, the abolition of all hard fibrous materials that made varnish impregnation uncertain and very ununiform, and, above all, the elimination of cellular air spaces in the windings and insulating materials, would result in putting discussions on chemical action in the windings of electrical machinery out of date.

The Authors, in reply, said that the figure of 35 volts per mil for the average stress in the slot insulation was recommended as safe for machines at their maximum working temperature. With the material used, and for voltages up to the maximum at present employed, the thickness of the insulation required to prevent chemical action was more than sufficient to meet the voltage requirements. Only where stress was forced much higher than 35 volts per mil would this feature have to be taken into account. In addition to the effect of temperature on the insulation mentioned by Mr. Walker, the chemical action was also influenced by the same factor. The paper referred to the influence of the conductor on the deterioration of the insulation, whereas Mr. Symonds considered the effect of chemical action on the conductor itself. The suggestion that failure to ground was more likely to occur than short circuit between turns was entirely contrary to practical experience, and, moreover, did not appear to be borne out by the tests, since all the coils were at the same potential. Where chemical action was concerned, climatic conditions played a comparatively small part, although from a general insulation point of view, their influence was very important. Mr. Highfield's experience appeared to vindicate that of the authors, inasmuch as it was impossible to obtain a perfectly solid coil. It was especially interesting to note that the coils in the machines with which Mr. Highfield had had so much experience were mica insulated, and although some action occurred in the small air spaces which existed, this was presumably on the organic cements used for building up the mica, and the extent of the action was very slight. For machines under about 1,000 kw., Mr. Highfield's figure for a maximum limit was probably right. For larger sizes the authors were of the opinion that it would be possible to push the voltage much higher without incurring risks due to chemical action. Machines of 20,000 volts and higher were in satisfactory operation. For reasons given in the paper, the authors could not agree with Mr. Turner regarding the suggestion that varnish could be used satisfactorily to overcome chemical action in high-voltage windings. The suggestion that untreated cellulose materials were sometimes used on machines was accepted, but the authors were inclined to believe that such practice was confined almost entirely to very low voltages.

Electrolytic Bleaching.

In a paper read before the Society of Dyers and Colourists in Manchester last month, by Mr. Ernest Reuss, the author dealt with the theory and practice of commercial electrolysis, with the cost of working, and the advantages of electrolytic bleach. Pointing out that in a properly constructed electrolyser of brine, no chlorine should escape, but hydrogen only, he stated that the evolution of the latter was the cause of a certain loss through reversal of the reactions, whereby a portion of the sodium hypochlorite was reduced; this was the most important difficulty remaining, and there was no doubt that it would be solved in the future. By the addition of a chromate to the electrolyte, the reduction was hindered, and with a strong current at 14° C., 23 grammes per litre of chlorine could be obtained from a 10 per cent. solution of salt, while from a stronger solution 38·5 grammes per litre had been obtained. Paraffin oil, resin, &c., were said to have similar beneficial effects. The best temperature for the solution was 20° to 25° C. Common salt was the best salt for the purpose, and should contain at least 98 per cent. of sodium chloride.

The best electrolyser, he said, was that of Dr. Oettel, of Zurich, who proceeded on new lines, substituting carbon for platinum electrodes, and introducing automatic circulation; this was the only electrolyser made in England since the passing of the new Patents Act. The author described briefly a number of bleaching apparatus, most of which had proved too costly to work; Hermite, he said, had done most of the work of preparing the way and educating the public, but did not live to reap the reward of his labours. He made a very efficient bleaching liquor, and his process was used in many paper and linen works. He introduced the use of magnesium chloride in the solution, which prevented loss by reduction of the hypochlorite.

The author stated that with the Schuckert type, taking 50 amperes at 110 volts, with brine of 10° Beaumé, the output was 39·5 to 41 litres per hour of bleach liquor averaging 20 gm. active chlorine per litre, equal to 7·8-8·2 kg. active chlorine in 10 hours. With the Kellner electrolyser made by Siemens & Halske, on 110 volts, with brine at 15 per cent. density, and 23° C. maximum temperature, 60 amperes gave in 10 hours 550 litres of bleach of 20 gm. Cl per litre, equal to 11 kg. of chlorine, and consuming 83 kg. of salt. About 6 kw.-hours were required per kg. of chlorine. Messrs. Mather & Platt's electrolyser, taking 19⅓ amperes at 220 volts, consumed 6 kw.-hours and 9 kg. of salt per kg. of available chlorine, the salt solution having a strength of 6 per cent., and the bleach liquor having 7 gm. of active chlorine per litre.

The electrolyser with which the author was most familiar was the Oettel type, with carbon electrodes. In the best pattern, refrigerating coils were used, and the liquor was automatically circulated. This device held 750 litres of 15 per cent. brine, using, therefore, 112·5 kg. of salt. Working at 110 volts, 75-80 amperes, the bath in 10 hours yielded a solution having a strength of 14 gm. per litre. The energy used was 88 kw.-hours, and the output 10·5 kg. of available chlorine. The electrodes would last 18 months on a 10-hour working day, and could be renewed for £6 10s.

The author gave the following estimates of cost per charge per day:—

	s.	d.
Salt, 250 lb. at 12s. per ton	1	4
Energy, 88 units at ¼d.	1	10
Labour		2
Renewals and maintenance		3
Cost of 23 lb. active chlorine	3	7
Cost per ton active chlorine...	£17	9 0

With energy at ¼d. a unit, the cost would be £26 7s. 6d. per ton.

The liquid sodium hypochlorite bleach of 15 per cent. strength sold at £6 10s. per ton worked out at £43 6s. 8d. per ton of active chlorine, and if made from bleaching powder and soda ash the cost was £23 11s. 3d. per ton. Liquid calcium hypochlorite cost £35 14s. 3d. per ton of active chlorine, and the ordinary bleaching liquor as made by bleachers worked out at £16 12s. 6d. per ton of chlorine.

But although electrolytic bleach was not so cheap as bleaching powder, it possessed advantages which more than counter-balanced the difference in cost. Used immediately after making, whilst warm, it could be diluted more than other agents and still bleach better; there were no precipitates, no lime residues, and the spent liquor being merely salt water, it could be discharged into sewers, &c., without creating a nuisance. Not being alkaline, it bleached more quickly and gave better and more enduring whites. When bleaching powder was used the deposit of lime on the fabric was very objectionable, and had to be removed with acid, which in turn had to be eliminated. Users agreed that goods bleached with electrolytic bleach were of better quality than those treated with bleaching powder.

In the manufacture of artificial silk, electrolytic bleaching held the field, being employed by over a dozen of the largest manufacturers; it was also preferred for woollens. The author also referred to the uses of electrolytic sodium hypochlorite for sterilising drinking water and swimming baths, and in hospitals, where, unlike chloride of lime and carbolic acid, it never choked pipes or drains. All the great German passenger liners used electrolytic bleach for laundry purposes, and the Cunard Co. had recently copied their example.

It was claimed that the outlay was repaid in the first year, due to the prolonged life of the linen—an important item, as the *Mauretania* alone, each time she came into port, had about 80,000 articles in the wash.

Tramcar Fatality.—A boy named Richard Talbot (7), son of a Blackburn tramcar driver, took his father's tea to his car on March 2nd. The father having taken the tea restarted the car. The boy ran alongside for a little distance, holding the pole which is used for changing the trolleys. Suddenly he slipped and fell under the car, the back wheels going over both his legs, and breaking them below the knee. He died the same night in hospital from shock.

A 10,000-VOLT STORAGE BATTERY.

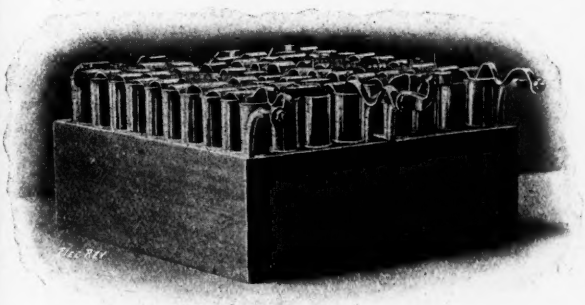
The meeting of the Röntgen Society at Mr. A. Campbell Swinton's office on Thursday, March 2nd, was obviously dictated by the fact that a 10,000-volt storage battery cannot be carried round upon a taxicab. It was, therefore, a case of Mahomet, in the shape of the persons interested, going to the decidedly compact mountain, where Mr. Swinton not only explained the construction of the battery, but illustrated a number of experiments with Crookes tubes. In his introduction to the experiments, Mr. Swinton explained that the battery was constructed because of a suggestion made by Sir William Crookes at the Royal Society, that it would be well to reproduce the experiments carried out some 30 years ago on vacuum tubes and cathode rays, but using high-tension direct-current discharges in place of induction coils. Mr. Swinton referred to Warren De la Rue's 10,000-volt battery of chloride of silver cells, made about 30 years ago, used on the De la Rue and Miller researches, and presented to the Royal Society. More recently—10 years ago—Prof. Trowbridge's battery of 20,000 cells was built.

Mr. Swinton's battery consists of 4,800 cells. For the purpose of charging off the supply company's mains, it is divided into sections. Pure Planté plates, formed from sheet lead pressed into a corrugated form, are contained in test tubes $\frac{3}{4}$ in. diameter and 4 in. long. Celluloid separators are used. All plates are formed in a "nursery" battery before being placed in the glass cells. The cells themselves are contained in a cast block of paraffin wax. The best charging current had been found to be 10 milliamperes; bubbling of the acid, which would cause surface leakage, was thereby prevented. A maximum discharge rate of 150 milliamperes for two to three minutes was afforded. The output was regulated by a water resistance in which wires could be lifted up or down. A rather elaborate main switch of vertical glass tubes containing mercury was used; the circuit was closed by wires dipping into the mercury, the contact being made and broken under oil. The battery was capable of giving a highly dangerous discharge.

In the first experiment the battery was used to charge a Leyden jar, while the second repeated the curious and unexplained phenomena in electro-capillarity first observed by Lord Armstrong in connection with his hydro-electric machine, and later, with an induction coil. A thread is passed through an orifice in a diaphragm in a vessel containing pure water; on applying an E.M.F., either the thread was drawn into the vessel through the orifice and the liquid was expelled, or *vice versâ*, according to the direction of the current.

Then came experiments showing the mechanical effects produced by cathode rays, such as the mechanical rotation of vanes and wheels. Also, the emission of feeble X-rays was shown. Finally came some very striking demonstrations of the production of striae in a long exhausted tube, with all their remarkable beauty of colour and movement, of increase and diminution.

After the President had well voiced the feeling of admiration shared by all present, Mr. W. Duddell referred to the H.T. D.C. testing battery at the Reichsanstalt, Berlin, which was capable of giving 1 ampere. He did not think that such batteries would be constructed again, as their function would be filled by influence machines. Or, indeed, they might tap on to the mains of a Thury system or use a number of 500-volt machines connected in series. On the other hand, with a battery, Mr. Swinton did not introduce a disturbance into the system from

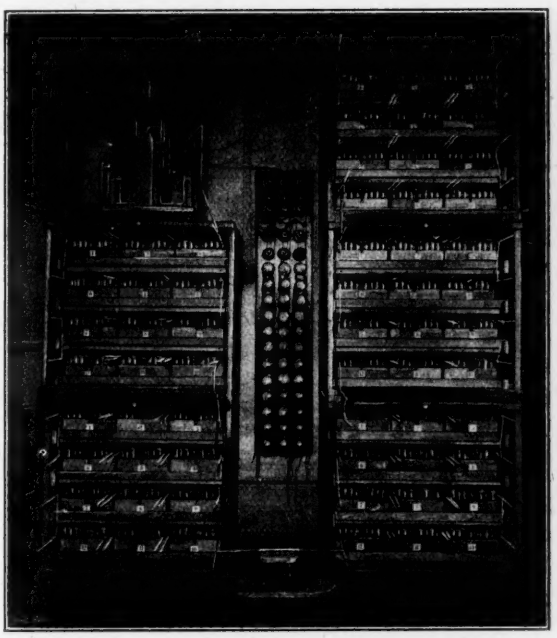


A Pair of Blocks, each containing 40 Cells.

his source of E.M.F. He asked, however, whether a continuous discharge through gases could really be ever obtained. Perhaps the stratification was due to this, or it could, perhaps, be accounted for by Sir J. J. Thomson's hypothesis, which ascribed it to ionisation. Passing to the battery, he remarked that he had made a fairly large battery along somewhat similar lines, but had used a charging current of 100 milliamperes; also he had used glass plates instead of celluloid separators, and he inquired how the latter lasted.

The discussion was continued by other speakers; one confessed to having made efforts in the same direction as Mr. Campbell Swinton, but without success. Creeping of the acid had been the chief difficulty. He implored Mr. Swinton to maintain his present battery, in the interests of science. Several outstanding problems would depend on it for settlement.

Reference was made by other speakers to Muirhead's large battery of dry cells used for testing condensers, and to the cost of upkeep of the De la Rue battery, which had amounted to about £200 per annum. It was also asked whether condensers could be charged in parallel and discharged in series.



Mr. Campbell Swinton's 10,000-volt Storage Battery, with H.T. Switch.

In reply, Mr. Campbell Swinton assured Mr. Duddell that no difficulty had arisen with the celluloid separators, although the battery had been in use for two years. He attributed its good condition solely to the low charging current. Planté had charged condensers in parallel and discharged them in series, but there were considerable insulation troubles.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"Regulation" writes:—"A local authority purchases E.H.T. energy in bulk from one of the power companies. This energy is converted to low tension by static transformers, and distributed to consumers under a provisional order.

"By the B.O.T. Extra-High-Pressure Regulations, issued April 24th, 1906, the power company are allowed a variation in pressure not exceeding the declared minimum pressure by more than 12 per cent. Under the B.O.T. Regulations for provisional orders, issued in 1909, the undertakers are only allowed a variation of 4 per cent. It is not possible to use rotary transformers and automatic voltage regulators.

"Can the local authority, under these circumstances, be compelled to comply with the 4 per cent. regulation, or does the fact that the power company are fulfilling their statutory obligations absolve the local authority from liability?"

*** It appears to be clear, having regard to the text of the regulations which determine pressure in the two cases of ordinary consumers and the consumers of supply in bulk, that the point suggested is a *casus omissus* in the Electric Lighting Acts. By Clause 3 of the regulations which affect ordinary consumers, the declared pressure "shall be constantly maintained, subject to a variation not exceeding 4 per cent. under any conditions of supply which the consumer is entitled to receive, or such variations as the Board of Trade may from time to time allow, and shall not be altered or departed from to an extent greater than that variation," except by consent of the Board of Trade. The Board of Trade Regulations as to extra-high-pressure provide (under heading B (3)) that in the case of bulk supply "before commencing to give a supply of energy at extra-high-pressure to any authorised distributor, the undertakers shall declare to the authorised distributor the minimum pressure at which they propose to supply energy at his terminals. Energy shall be supplied at a pressure not less than the minimum so declared, and not exceeding that minimum by more than 12½ per cent.; provided that the Board of Trade may, if they think fit, allow an alteration in the minimum so declared, upon such terms and conditions as they may think expedient, and after public notice has been given during a period of one month, in such manner as the Board of Trade may require, of the intention of the undertakers to apply for consent to alter the minimum so declared." It appears to be difficult to reconcile the duties imposed by these two sets of regulations. The answer to the difficulty is that the local authority are under no compulsion to obtain a supply from authorised distributors.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

4,246. "Carburetters." J. C. Owers. February 20th. (Complete.)

4,252. "Shock-absorbing devices." L. A. Peckham. February 20th. Complete.)

4,266. "Vapour electric apparatus." M. A. F. Leblanc. February 20th.

4,282. "Telephone systems." W. J. Rickets. February 20th.

4,286. "Electric motors." W. R. Macdonald. February 20th.

4,287. "Electric motors and pumps." W. R. Macdonald. February 20th.

4,300. "Plough for the conduit tramway system." J. Murray. February 20th.

4,316. "Remote-controlled electric gas igniter." W. Theim. February 20th. (Complete.)

4,356. "Means for securing shades and lamps to electric lamp sockets, said means being also suitable for securing shades to inverted incandescent gas burner." A. C. Lauder. February 21st.

4,385. "Means for operating electric railway tracks, points and switches." P. M. Justice. (American Automatic Switch Co., United States.) February 21st. (Complete.)

4,397. "Overhead electric trolley wire construction." Oesterreichische Daimler Motoren Akt-Ges. (Convention date, October 22nd, 1910, Germany.) February 21st. (Complete.)

4,405. "Secondary batteries or storage cells." V. de Karavodine. February 21st.

4,414. "Electric sounders." E. R. Grote. February 21st.

4,431. "Electric signalling system for railways and the like." J. Robertson. February 23rd.

4,434. "Electric bell connection between engines while in motion." L. Brown. February 22nd.

4,457. "Time limit or retarding devices for use in connection with electric circuit-breakers." Electric and Ordnance Accessories Co., Ltd., and N. Collins. February 22nd. (Complete.)

4,488. "Transmitter for signalling by electromagnetic waves." F. J. Chambers. February 22nd.

4,491. "Device for supporting or suspending electric lamps and the like." G. P. Kent and A. R. Mitchell. February 22nd.

4,498. "Electromagnetically controlled perforating mechanism." M. Kottra. February 22nd. (Complete.)

4,521. "Combined double and single-pole switch." Peto & Radford, Ltd., and H. M. Genese. February 22nd.

4,524. "Electric accumulator boxes." G. F. B. Pritchett. (Addition to 15,425/1910.) February 22nd. (Complete.)

4,580. "Electric alarm for incubators and the like." A. J. Gaunt and Dairy Outfit Co., Ltd. February 23rd.

4,602. "Process for the closing of the seams of tubes by means of electrical resistance welding." D. Timar and E. Presser. (Convention date, May 20th, 1910, Germany.) February 23rd. (Complete.)

4,611. "Tramway switches." A. Sheithauer and R. Kliche. February 23rd. (Complete.)

4,618. "Circuit connections for electric current distribution with transformers." F. Kesselring. February 23rd. (Complete.)

4,623. "Suspension of electric conductors." Allgemeine Elektricitats Ges. (Convention date, February 24th, 1910, Germany.) February 23rd. (Complete.)

4,627. "Method of starting and regulating the speed of alternating-current motors." A. Heyland. (Convention date, February 24th, 1910, Germany.) February 23rd. (Complete.)

4,805. "Attachment for wires used for electrical conduction and other purposes." J. C. Watson. February 25th.

4,806. "Construction of electric relays." E. I. Parkes. February 25th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Means for Controlling Electric Motors. W. Wittek. 30,262. December 28th.

1910.

Printing Telegraph. Dr. L. Cerebotani and A. Silbermann. 16,253. July 10th. (July 7th, 1909.)

Central-Energy Electrical Signalling System. H. C. Francis. 16,329. July 8th.

Stator Windings for Single-Phase Electric Induction Motors. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 18,837. August 10th.

Electric Advertising and Signalling Apparatus. C. J. Herbeck and L. Holz. 19,282. August 17th.

Process for the Manufacture of Sheets, Bands, Wire, and the like of Electrolytic Iron. Langbein Pfanhauser-Werker Akt.-Ges. 22,204. September 24th. (September 28th, 1909.)

Magnetic Deflectors for Electric Arc Lamps. A. Bisson and G. Berges. 28,382. May 27th. (Divided application on No. 12,149 of 1910. May 17th.)

Manufacture of Electrodes for Secondary Batteries or Storage Cells. S. B. Apostoloff and V. de Karavodine. 66. January 1st.

Means for Producing Sound-Waves. L. E. Cote and W. E. Kelley. 2,083. January 26th.

Electrical Current-Limiting Devices. British Continental Electricity Co. (W. A. Brodie.) 2,057. January 27th.

Appliances (Wearing) for the Production and Circulation between different parts of the body of mild Electric or Galvanic Currents, for the Relief and Cure of Rheumatic, Gouty, Nervous and other Disorders. J. J. K. Short and O. Short. 2,187. January 29th.

Oil-Switch Electric Cable Boxes. J. Herbing. 2,311. January 29th.

Electrical Device for Transmitting to a Distance Continuous or Intermittent Angular Movements. F. Spalazzi 2,683. February 2nd. (September 18th, 1909. Addition to No. 11,858 of 1909.)

Electric Switches. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 2,981. February 7th.

Magneto-Dynamo Armatures. R. N. Cunningham. 3,802. February 15th.

Means for use in Controlling Induction Motors. Electric Construction Co. and N. Pensabene. 4,736. February 25th. (Cognate application, No. 13,961 of 1910.)

Current Commutation of Commutator Frequency Converter. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 5,479. March 4th.

Process for Producing Porous Electro-Deposits. W. E. Lake. (Fabrik Elektrischer Zünder Ges.) 5,691. March 17th.

Protective or Indicating Devices Operative on Leakage Currents for use in Continuous-Current Transmission and Distribution Systems. British Thomson-Houston Co. and E. B. Wedmore. 6,292. March 14th.

Driving of Electrically-Propelled Vehicles. Akt.-Ges. Brown, Boveri et Cie. 6,404. March 14th. (April 2nd, 1909.)

Means for Supporting Electric Wiring Conduits in Position. H. P. Staniar and A. E. Clegg. 6,589. March 16th.

Electric Measuring Instruments. British Thomson-Houston Co. (General Electric Co.) 6,894. March 18th.

Electric Switches. P. Druseidt. 9,399. April 18th. (Convention date not granted.)

Form of Current-Limiter for use with Fixed-Rate Systems of Charging for Electrical Energy and for other purposes. E. E. Hoadley and H. Tindall. 10,654. April 30th.

Electric Switches for obtaining Contacts of Short Duration. W. Rausch. 10,799. May 2nd.

Telephonic Apparatus. E. O. Graham. 10,965. May 3rd.

Construction of Telephone Receivers. M. S. Conner and Peel-Conner Telephone Works, Ltd. 13,177. May 31st.

Insulating Device for Electric Lamp Holders. N. Hirst and H. I. Coates. 13,481. June 3rd. (Addition to No. 17,101 of 1909.)

Electric Liquid Heaters. W. F. Cutler. 13,864. June 8th.

Means for Controlling the Speed of Electric Motors. Siemens-Schuckertwerke Ges. 14,345. June 14th. (June 14th, 1909.)

Central Energy Electrical Signalling System. A. Goldstein and C. Pool. 16,380. July 8th.

Electrodes for Arc Lighting. British Thomson-Houston Co. (General Electric Co.) 17,278. July 20th.

Electrical Fuses for Blasting and like purposes. W. E. Malson. 17,694. July 26th.

Automatic Governors or Electric Regulating Devices. Soc. Anon. Ateliers H. Cuenod. 20,957. September 8th. (September 13th, 1909.)

Electromagnetically Operated Switches, particularly adapted for Controlling Electric Motors. E. Schattner. 22,842. October 3rd.

Continuous-Current Dynamo Machines. Fried. Krupp Akt.-Ges. 25,167. October 29th.

Electro-Metallurgy in Norway.—H.M. Consul at Christiania states that a new company has been formed, under the name of the "Stavanger Electro-Staalverk A/s," with a capital of about £25,000, for the purpose of utilising scrap iron and steel from broken-up vessels, workshops, &c., for the electrical production of high-quality steel. Works are to be erected at Jörpeland, near Stavanger, in Ryfylke, where the company has secured a supply of 2,500 H.P., which, it is said, could be increased to 10,000 H.P. The annual output is estimated at 1,400 tons of high-grade steel billets, 600 tons of cast-steel, 300 tons of hammered steel, and 700 tons of scrap for re-smelting. It is proposed to commence operations this year.

The directors of the Tinfos paper mills have turned over the electric iron-ore smelting undertaking at Notodden to a newly formed company named the "Tinfos Jernverk, A/s.," Notodden, with a capital of about £55,500.

A new undertaking for the electrical smelting of iron, known as the "A/s Arendals Fossekompagni," has been established at Arendal, under the management of Mr. Eyde. The new company is an extension of an old undertaking of the same name, the capital being increased to £233,300. It is reported to own the Böile Foss, near Arendal, a waterfall capable of affording 30,000 H.P., of which it is proposed at first to harness only 12,000 H.P. The company has obtained the right to use the A/s Electrometals Swedish (Grönwall) process, and has also acquired ore deposits near Arendal.

The Ilen Smelting Works, of Trondhjem, are stated to have decided to turn their attention to the electrical smelting of metals. The process to be employed is described as the invention and patent of the director of the works, Mr. Tharaldsen. Trial smeltings are being started with a furnace of 1,000 H.P., chiefly for copper smelting, with an estimated producing capacity of 2,000 tons per annum. A second furnace for iron smelting of 3,000 H.P., and capable of producing 9,000 tons per annum, is expected to start work in the spring.

A consignment of 25 metric tons of pure copper, the first copper produced by electrical smelting in Norway, has recently been exported from the Birtavarra mines, at Kaafjord, near Lyngör. The company working these mines have recently considerably extended its works and has adopted a new method of electric smelting.

The "A/s Kristianssands Nikkelraffineringsverk," Christiansand, is about to undertake the electrical smelting and refining of nickel and copper.—*Board of Trade Journal.*

The *Manchester Daily Guardian* says a new company has just been formed, the Hardanger Elektriske Jern og Staalverk, with a capital of 1,100,000 kr.; two iron furnaces, each of 2,900 H.P., and one steel furnace of 800 H.P. are being erected, and a rolling plant to deal with 6,800 tons per annum is being built. A 30 years' contract has been entered into with the Aktieselskabet Tyssefoldene for the delivery of 4,200 H.P. at 30 kr. per H.P.-year. Another company is also being formed to work the process of the Norwegian engineer Lorentzen. Current will be delivered by the Tinfors Jernoers Aktieselskab, who undertake to provide 10,000 H.P. at 20 kr. per H.P.-year, the contract being for 20 years. It is estimated that the annual output of iron will amount to 10,000 tons, the producing cost being worked out at 51·82 kr. per ton and the selling price at 63 kr. per ton. In this calculation the cost of energy is estimated at 12·83 kr. per ton, coke 7·67 kr. per ton of iron produced, and ore 14 kr. per ton of iron.